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The Heating and Ventilating Magazine

A Monthly Journal of Engineering Progress

Vol. XXIV.
No. 10.

OCTOBER, 1927

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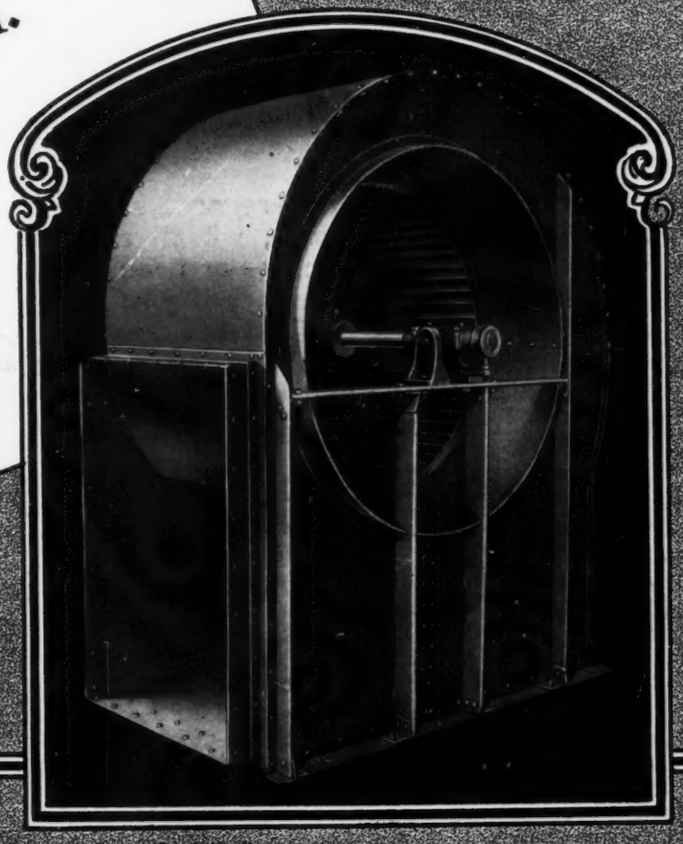

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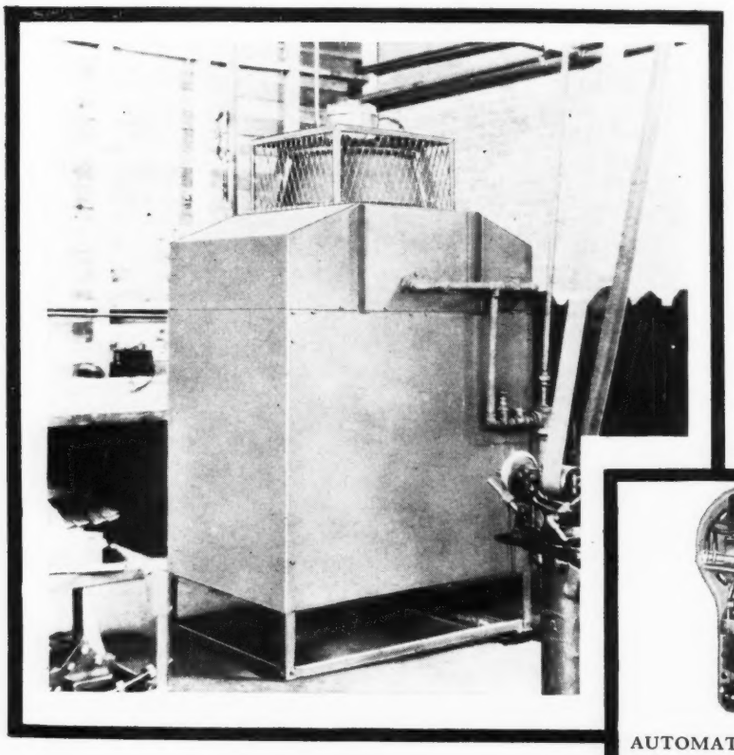

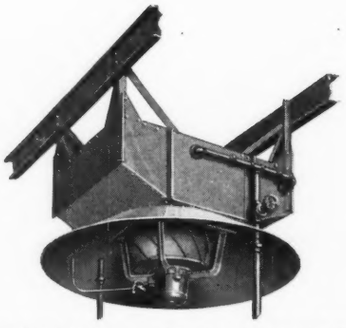

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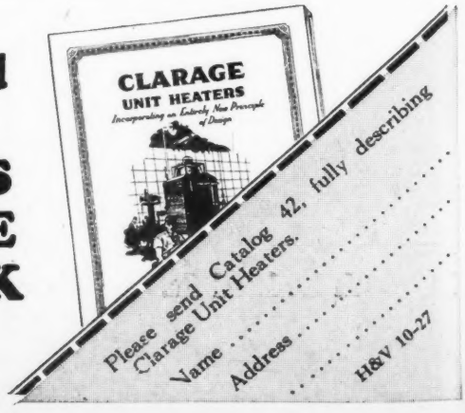

The Heating and Ventilating Magazine

VOL. XXIV — Reg. U. S. Pat. Off. Reg. Canadian Pat. and Copr't Off. — No. 10

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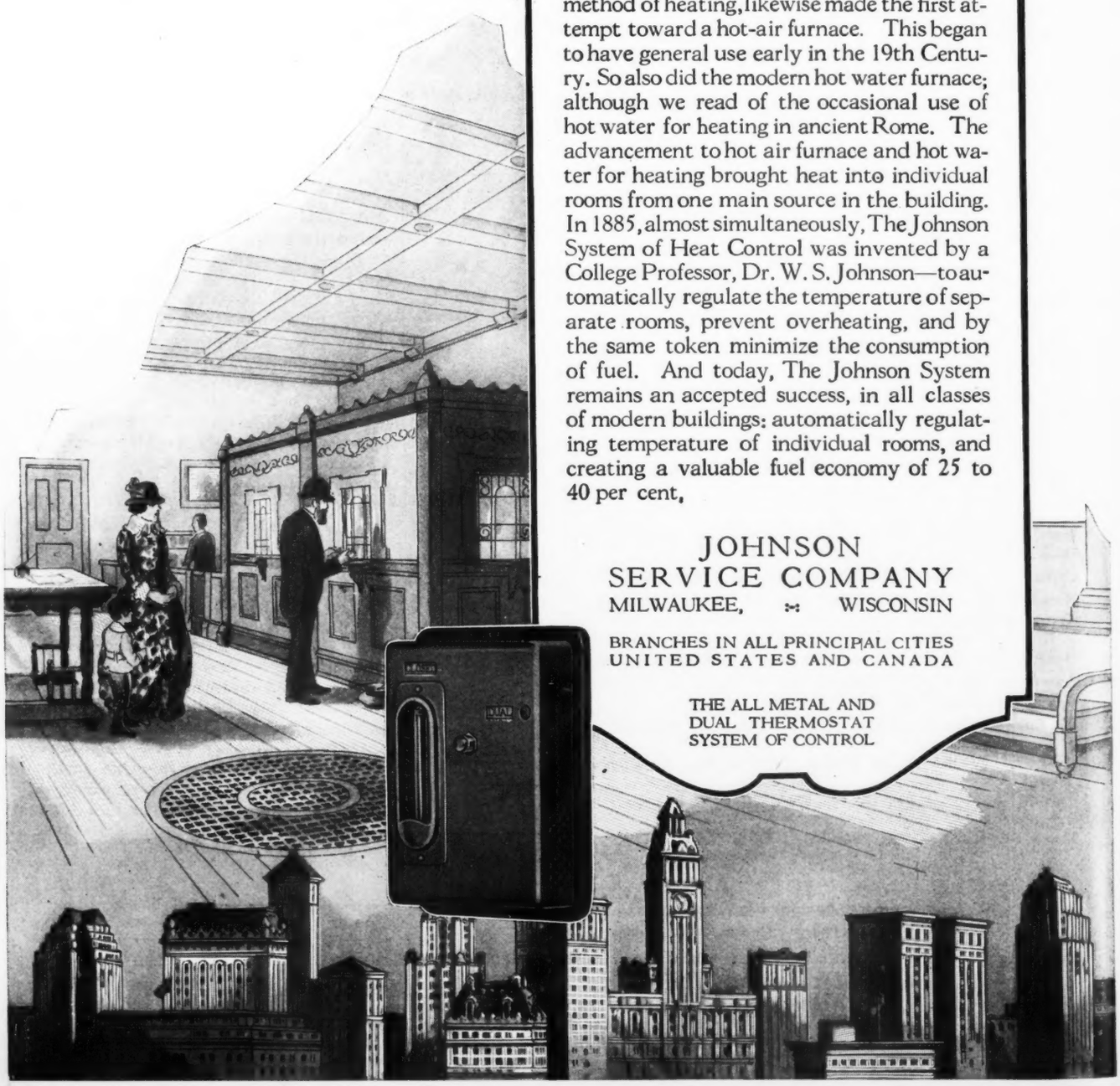

The Heating and Ventilating Magazine

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The Influence of High Buildings on Heating Design

Typical Problems Involved in This Class of Work, Showing Adaptability of Overhead Down-Feed Vacuum Steam System

By Harold L. Alt

MODERN skyscrapers involve many problems in connection with the arrangement of their heating systems which are not encountered in lower structures. It is the purpose of this article to discuss a few of these problems for the benefit of the reader and to offer some suggestions which may be of value in the next high building encountered.

As buildings rise, story by story, from the basement toward the roof, the distance from the boiler to the farthest radiator becomes greater and greater, necessitating larger pipe sizes and giving greater amounts of expansion with which to deal. When structures are carried up to about fifty stories, the vertical distance alone is in the neighborhood of 600 ft., to which must be added the horizontal runs. When the overhead down-feed system is used, the length of the drop also must be included and the piping planned so that the pressure-drop between the boiler and the last radiator will be within reasonable limits.

It is quite true that such lengths of run previously have been encountered in lower buildings in a horizontal direction where pressure-drop may be taken care of by proper sizing of the lines, but with the matter of expansion the solution is not so simple. Where, in the long runs in low types of buildings, there was ample opportunity to take care of the lengthening and shortening of the pipe by bends, breaks, loops or offsets, no such means usually is practicable in the long vertical runs necessary in high buildings. There the main risers, as generally placed in pipe shafts in which space conditions are very limited and having lateral branches at various points, demand an absolutely fixed position of the riser where such branches occur.

ADVANTAGES OF OVERHEAD DOWN-FEED SYSTEM IN HIGH STRUCTURES

The overhead down-feed system has certain advantages for use in high structures, owing to the possibility of making the drops smaller for the same amount of radiation, due to the condensation flowing in the same direction as the steam in the riser; besides this, the large horizontal distribution mains may be placed in the upper stories where space is not so valuable as in the basement and first-floor sections. Such an arrangement results in the risers getting smaller as they progress toward the lower part of the building, leaving only very small steam pipes at the first floor and the returns, which are not of large size, anyway.

Assuming that an overhead down-feed system has been decided upon, the next step is to consider and adopt the most suitable type of heating which is applicable to a building of the size contemplated. As in ninety-nine cases out of one hundred the vacuum system is used, this article will be limited to the consideration of that system.

The radiation having been calculated by any of the standard and dependable methods, the next feature to be taken up is the method and details of feeding the drops. This usually is determined by the building construction, combined with the limit in the size of drops; if no drops larger than

3 in. are desired, the horizontal feed-mains must be located at such levels as to keep the size of drops down to the limit set. On the other hand, if the drops can be run up to 4-in. size, there will not have to be as many horizontal feed-mains as when the drops were kept down to 3-in. size.

FIGURING RISER SIZES FOR 50-STORY BUILDING

In Fig. 1 is shown a typical riser diagram for a 50-story building in which it has been assumed that the radiation for each bay comes to 70 sq. ft., with 90 sq. ft. on the top floor to include roof losses. Of course, this radiation on an actual job would not figure out exactly like this, as varied arrangements on the different floors would introduce altered radiator sizes, but the above will serve for illustrative purposes.

If a *single drop* were used for each bay in this building, there would be a radiation load on the drop of

70 x 49.....or 3430 sq. ft.
90 x 1.....or 90 sq. ft.

Total ..... 3520 sq. ft.

Now with a vertical riser 600 ft. high and a corresponding drop of another 600 ft., the total length of vertical pipe is

600 ft. for riser
600 ft. for drop

1200 ft. total

Allowing, say, 100 ft. horizontal run in the basement to connect up with the boiler, and about 150 ft. on the top floor for the horizontal distributing main, the total horizontal length of main is

100 ft. in basement
150 ft. in roof

250 ft. total.

With these figures it is easy to see that the maximum length of run from the boiler to the farthest radiator amounts to the sum of the total vertical run, plus the total horizontal run, or

1200 ft.
250 ft.

1450 ft. total length of run.

Therefore, in sizing the lines a pipe-sizing schedule based on 1500 ft. run must be used and the risers also may be sized from this schedule, inasmuch as the condensation is flowing in the same direction as the steam. Near the bottom of the drop the size should be increased one pipe-size to take care of the drop condensation without reducing the steam capacity of the drop.

In sizing up steam lines it always must be remembered that the valves, fittings, and bends introduce additional resistance, and, in ordinary systems, this additional resistance is almost 100% that of the pipe. Consequently, if a pipe-sizing table is used which is based on, say, ½-lb. loss for straight pipe, then the actual loss is going to be approximately double this amount, or about 1 lb.

Assuming that a first-class operating system is desired, the total pressure-drop in the steam line may be assumed as being about 1 lb., which means that a pipe-sizing table based on ½-lb. drop for *straight* pipe will have to be used. Referring to a ½-lb. drop table in any standard authority, it is found that for 1500 ft. run the permissible loads in square feet of radiation are as follows:

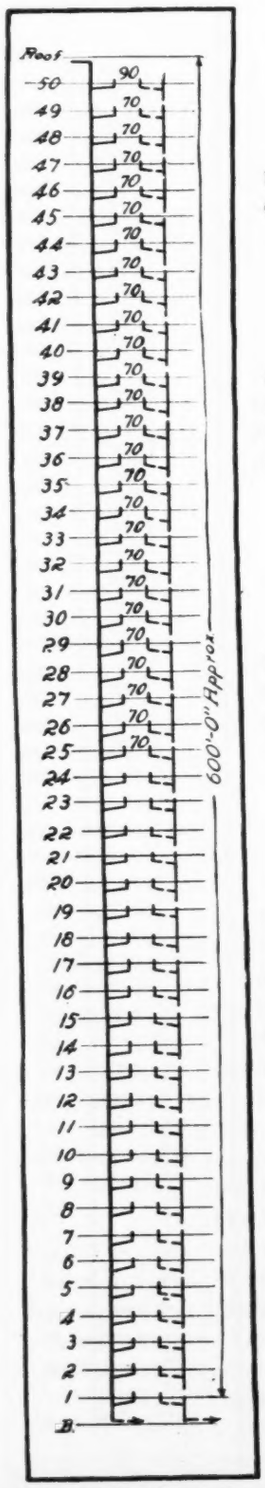


Fig. 1. Riser Diagram for 50-Story Building With All Radiators in Each Bay on a Single Riser

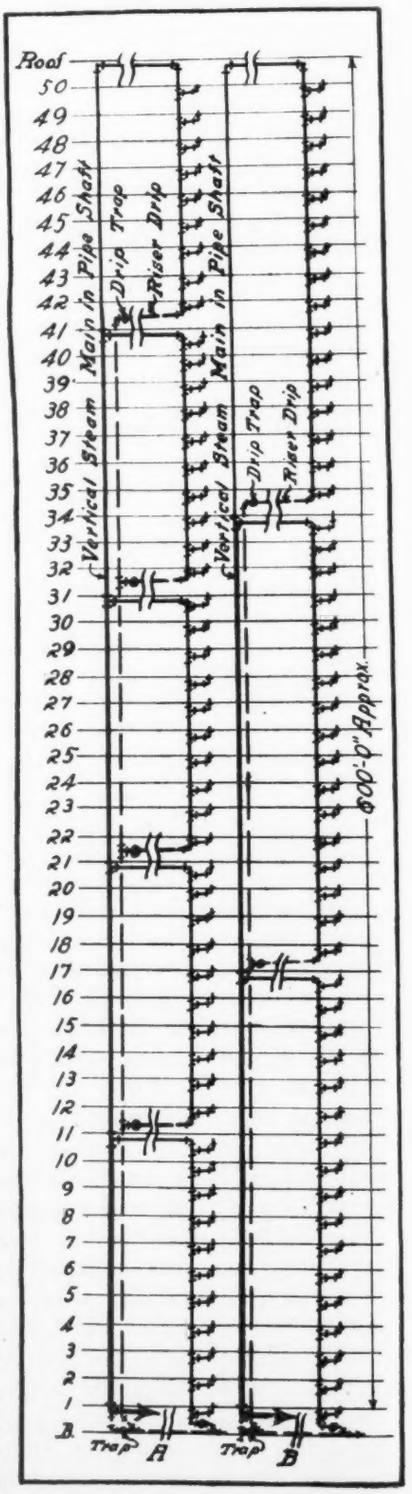


Fig. 4. Arrangement of Distribution System for 3-In. Drops—"A." Arrangement of Distribution System for 4-In. Drops—"B."

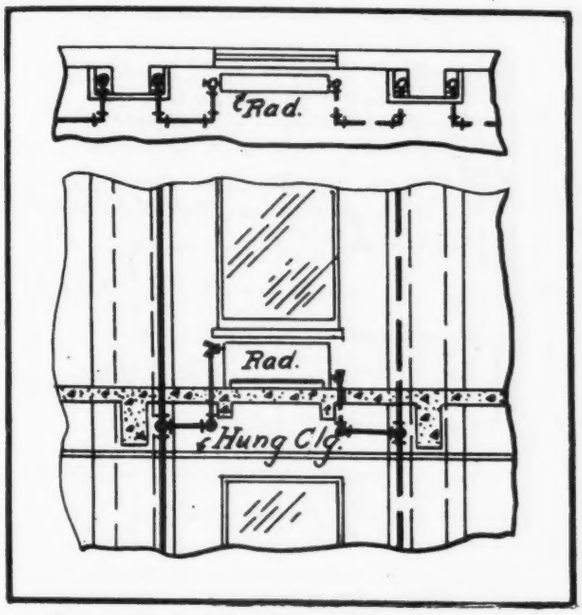


Fig. 2. Typical Conditions Where Drops Feed Radiators on One Side of the Column Only

Size of Pipe In. Diam.	Sq. Ft. of Radiation
1½	102
2	246
2½	386
3	700
3½	1020
4	1440
5	2560
6	4080
8	8440
10	14750
12	23600

Inspection of this table shows at once that the size of a single drop, carrying 3520 sq. ft., will be 6 in., which also presupposes that the drop feeds only one bay; that is, the radiators on the right side of the column only. If the drop feeds on both sides, the radiation load will be twice as much, or 7040 sq. ft., involving 8-in. drops, which, of course, are entirely unreasonable. Fig. 2 illustrates a drop feeding on one side only and necessitates two risers on each column, while Fig. 3 illustrates a drop feeding on two sides and requiring only one riser on each column.

In lower buildings the method shown in Fig. 3 generally is used, but in high buildings the method given in Fig. 2 not only reduces the size of drop but also avoids the crossing of the column with a branch to the other side, thus eliminating a lot of fittings and breaks around the column.

DETERMINING NUMBER OF DROPS

To go back to the pipe-sizing schedule and adopting the double-drop scheme, shown in Fig. 2, it is found that, if the drops are to be kept down to a 3-in. size, the radiation load must not be over 700 sq. ft., while, if a 4-in. limitation is set, the radiation load cannot exceed 1440 sq. ft. As the total load on each drop is 3520 sq. ft., it may quickly be seen that, with 3-in. drops, the *number* of drops required will be

3520/700, or 5 drops

while, with 4-in. drops, the number required will be, similarly,

3520/1440, or 3 drops.

This means that with 3-in. drops there will have to be five sections or levels in the building, each fed by its own horizontal distribution system, whereas with 4-in. drops there will be only three horizontal sections fed from three horizontal distribution systems. This is shown in Fig. 4, where "A" indicates the arrangement with 3-in. drops and five distribution systems and "B" the same arranged for 4-in. drops with three distribution systems.

There are certain advantages in placing two supply drops on a column and two return drops on the next column and so on, alternately, all around the building; as long as the drops are not feeding across the face of the column, there are no disadvantages to this scheme as the drops in one bay are entirely separate and distinct from the drops in the next bay.

APPLICATION TO SECTIONAL CONTROL

The advantages develop where the return drops are located at the points where the divisions come in the heating main distribution; that is to say, where more than one main riser is used, each riser should supply a certain section of the building at each level of horizontal distribution and return drops should be located on the columns between the sections. This will be more plain if reference is made to Fig. 5 where main riser "N" supplies the north section and main riser "S" supplies the south section. Still better is to use four risers and to employ one to feed each quarter, or side, of the building such as the northwest quarter, the southwest quarter, the northeast quarter and the south-

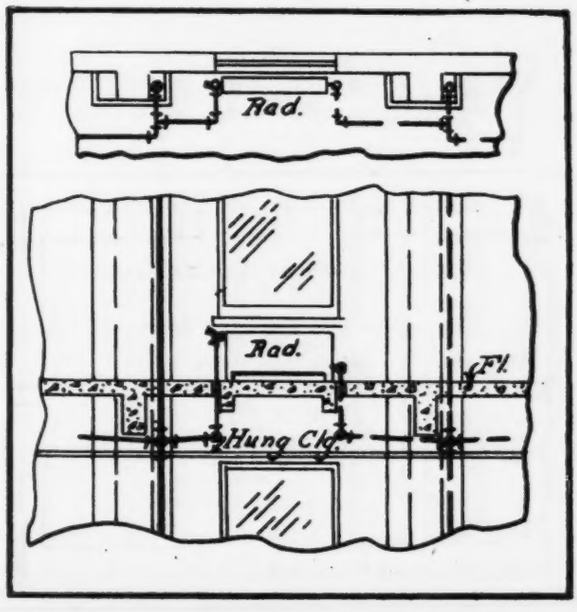


Fig. 3. Typical Conditions Where Drops Feed Radiators on Both Sides of the Column

east quarter, or the North, West, South and East sides.

Where this is done the returns similarly are divided and there is a separate return from each section to correspond with the steam supply. Then it is possible to carry a different steam pressure on each section of the building—by means of separate reducing valves in the basement—and to compensate for varying wind exposures on different days in this manner.

A building so piped is best controlled, as far as temperature is concerned, by the use of separate high-vacuum pumps—one pump being provided for each return for each individual section—and the use of a fixed differential between the steam pressure and the return line. This scheme has the advantage of making it possible to control the amount of heat delivered to each section in accordance with the requirements at that particular time and utilizes the minimum amount of power to drive the pumps, as the differential maintained is always the *minimum* at which the building can be circulated, regardless of the absolute degree of vacuum being carried in the system, or section of the system, at that time.

If long-distance thermometers or temperature indicators are located in key rooms, taking one typical room in each section as a standard, and these thermometers are run back to some common point in the basement, the engineer—by simply glancing at the dials on these thermometers—will know the exact temperature in each section of the building. If a strong north wind starts up and the temperature on the north side begins to go down, all he has to do is to decrease his vacuum on the north side main until the temperature comes back to the proper degree.

Contrarywise, when the temperature on the south side begins to climb around noon, due to the sun, all that is necessary is to increase the vacuum on the south section main steam line until his dial thermometer begins to drop back to its desired point.

In Fig. 6 is shown the connections for the returns in a building where four main steam risers

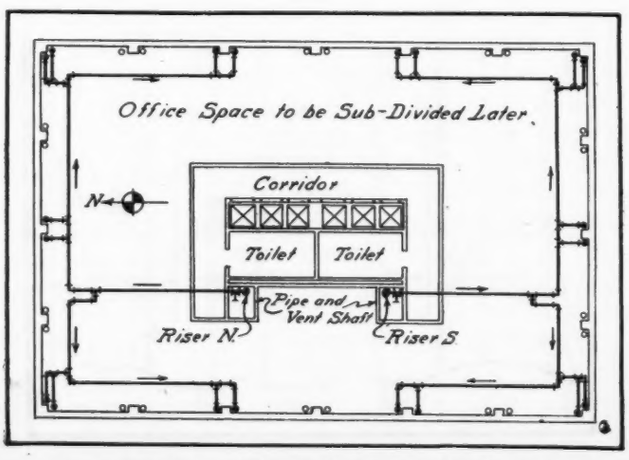


Fig. 5. Method of Connecting Drops for North and South Halves of Building

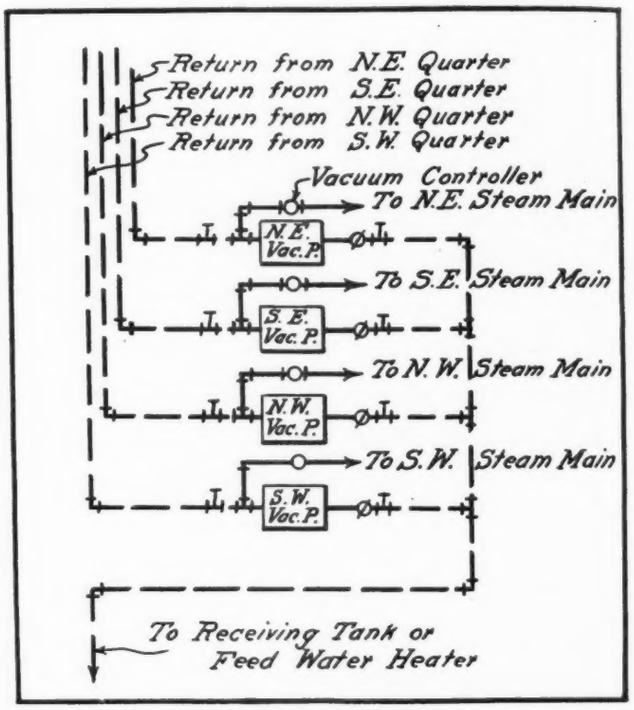


Fig. 6. Method of Connecting Returns to Separate Pumps for Sectional Control

are used, each riser having its own respective return and individual vacuum pump. Separate vacuum controllers, of course, are used on each pump and separate reducing valves on each steam main. With this scheme no temperature regulation beyond the vacuum control is necessary and tenants of the building cannot throw their radiators on full by opening their windows, as sometimes occurs where automatic temperature control alone is depended upon.

Repairs to Heating Coil in Water Heater

COMPLAINTS began coming in about failure of hot water supply from a coil-heated tank. For a while by-passing the return trap for a short period seemed to correct the trouble.

The day soon arrived when, with the steam valve full open, only a slight drizzle of cold water came from the return. Upon opening the tank we found a wiped joint in poor condition on the single 1½-in. copper coil. Tapping the coil between this wiped joint and the return showed the coil just beyond the joint to be full of scale. It developed that when the heater was installed the coil leaked, and to correct this condition a wiped joint or its equivalent was formed over the leak. The lead had disintegrated and could be broken off without tools. The water leaking through had practically filled a short section of the coil with scale.

The coil was cut open at the leak and the scale cleaned out. The question of how effectively to close the open coil with facilities at hand puzzled us. We solved it by expanding the open ends into a flange union from which the threads were removed.

Testing the Efficiency of Gas-Fired Warm-Air Furnaces

A New Method Developed at the A. G. A. Testing Laboratory Solves Troublesome Problem of Air Measurement

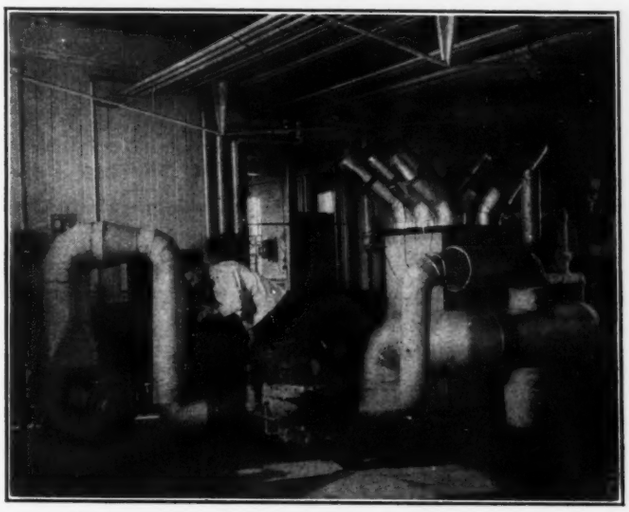
By George B. Shawn
American Gas Association Testing Laboratory

SINCE the Testing Laboratory began making approval tests on gas-fired warm-air furnaces, a great deal of interest has been developed in the method of efficiency test employed. There had been little co-ordination of the various test methods used in the past and as a result no laboratory has been willing to accept, at their full face value, the results of tests made by other laboratories. Disagreement on the method of heat-output measurement has been the greatest cause of difference. The chief interest in the efficiency tests made at the A.G.A. Laboratory centers on this measurement.

Accurate determination of the heat-output of warm-air furnaces has been so difficult to accomplish that the efficiency often is calculated by subtracting the actual heat lost in the stack from the heat content of the gas. The acceptance of this method is based on the assumption that all heat taken away from the jacket of the furnace by radiation and convection is useful heat, since it serves to warm the atmosphere immediately around the furnace and, to some extent, that of the building above. This view often has been held by gas furnace manufacturers in their own measurements of efficiency. Many gas-company laboratories, however, insist that radiated and convected heat should not be credited to the furnace, and determine the heat-output by direct measurement. This is usually attempted by means of an anemometer or Pitot tube and gauge. While these methods are fundamentally correct, many inaccuracies are bound to creep in. Anemometers cannot be called accurate unless a careful standardization is made before each test; the Pitot tube may be used with confidence only in the hands of a competent and careful experimenter.

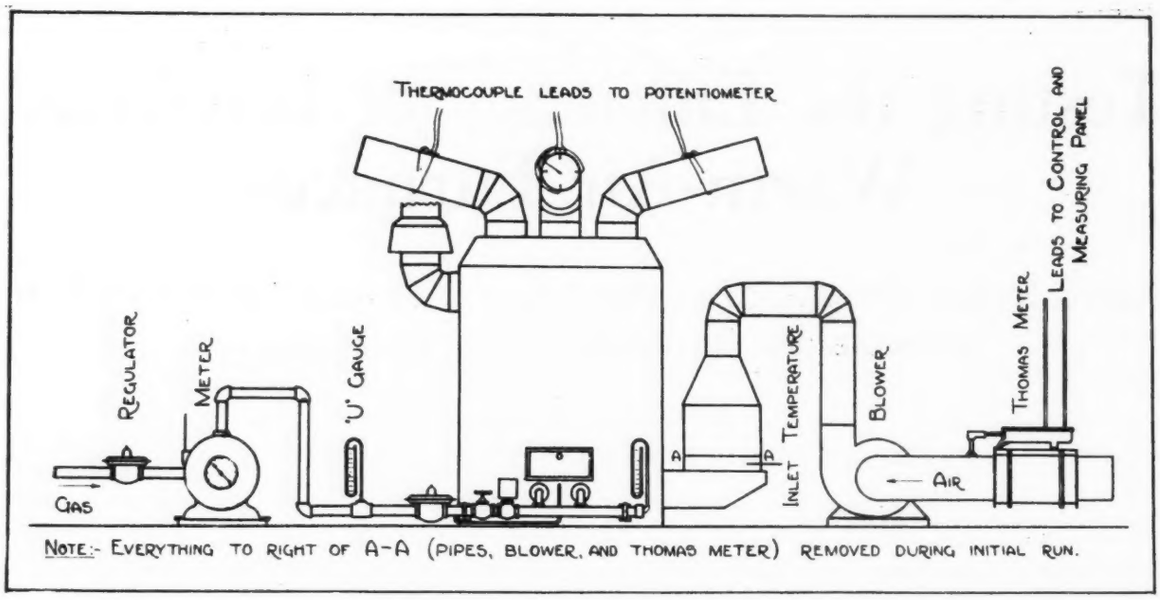
RESEARCH METHODS NOT APPLICABLE TO RAPID COMMERCIAL TESTING

During the past few years a large amount of research work on warm-air furnace performance has been carried on at the University of Illinois under the direction of Professor A. C. Willard. The progress reports on this work, Bulletins 112, 117, 120 and 141 of the Engineering Experiment Station, are an extremely valuable contribution to our knowledge of the subject. The method of measurement employed by Professor Willard and his associates for the determination of velocities in air ducts depends upon the accuracy of calibration and of use of the anemometer or Pitot tubes. They discovered that an anemometer could be used with a high degree of accuracy provided a calibration was made with air under conditions practically identical with those of the furnace test. A very delicate differential gauge was developed to secure the desired accuracy with Pitot tubes. Having made these advances, they were able to pursue their investigations with great success.



Recording Data in Gas-Fired Warm-Air Furnace Test

While the methods used by the University of Illinois are undoubtedly productive of invaluable results when applied to research, they require too much time and precise manipulation in operation to be practical for the large number of routine approval tests which must be made at the A.G.A. Testing Laboratory. In order to carry on this work with the desired rapidity it was necessary to develop a new method of heat-output measurement. Since the warm-air leaders were restricted to a length of 2 ft., in order to reduce the space required for a set-up, the use of Pitot tubes was



Set-Up for Testing Gas-Fired Warm-Air Furnaces, American Gas Association Testing Laboratory

out of the question. No direct means could be devised for metering the air without obstructing its flow, either at the inlet or outlet to the furnace. Consequently it was decided that the measurement should be indirect.

DETERMINING AIR TEMPERATURE INCREASE THROUGH FURNACE

The procedure is as follows:

The gas flow is adjusted at such a rate that the hourly B.T.U. input corresponding to the rating specified by the maker of the furnace, is secured. Gas is allowed to burn at this rate and at a constant line-pressure until the temperature of the air leaving the furnace has become constant. Knowing the rate of gas consumption and the gas pressure, it is a simple matter to compute the input to the furnace in B.T.U. Temperature of air at outlet and inlet is noted, and the difference is the temperature rise of the air while passing through the furnace. During this part of the test the cold-air inlet of the furnace is left unobstructed.

Temperature measurements in each warm-air duct are made by five thermocouples connected in parallel and placed in a potentiometer circuit which is balanced by a galvanometer of sufficient sensitivity to give an accuracy of about 1° F. This arrangement makes possible a determination of the average temperature of the air flowing through the duct. This completes the first portion of the test.

FINDING THE EQUIVALENT AIR VOLUME

The next step is to connect all the inlets to a single pipe, which in turn is connected to a metering device and fan blower. This blower is driven by a variable-speed motor which can be operated over a wide range of speeds. After these connections have been completed the gas again is lighted, the gas pressure and rate of flow being maintained the same as during the first part of the test. Starting the fan, the speed of the motor is adjusted to a point that will give a temperature rise of air identical with that previously obtained. Since the heat input, determined by the definite combustion rate, and the temperature rise of the air passing through the furnace are the same in the two cases, the volume of air must be the same per unit of time, as the efficiency of the furnace is fixed for that particular load.

It now remains to ascertain how much air is passed through the furnace to secure the desired temperature differential. A Pitot tube could be used except for the objections above cited. The laboratory, therefore, has made use of a metering device known as a Thomas meter. This consists of a jacket around a section of the air intake, containing an electric heating coil. A resistance thermometer is placed on each side of the resistance coil in the air current. These thermometers are protected from the heat of the coil by radiation shields. The indicating instruments used are a Wheatstone bridge and a carefully calibrated wattmeter. The resistance thermometers are placed in the Wheatstone-bridge circuit. This bridge has its resistances so arranged that it will be balanced at a definite temperature rise (2.22° F.). As the air flows by the heating coil its temperature is increased according to the amount of current flowing through the coil.

Adjustment of the heating current is accomplished by means of a rheostat until the bridge is balanced, indicating that exactly enough heat is being liberated to raise the temperature of the air just 2.22° F. After the bridge is balanced, the reading of the wattmeter is noted.

The rate of air flow then can be computed, knowing the specific heat of the air and the heating cur-

(*Continued on Page* 74)

Design of Heating, Ventilating and Cooling Equipment for Two Types of Theaters

I. Practical Application of Formulas and Theory to Typical Theaters, One With and One Without a Balcony

THEATER cooling is a comparatively new development involving, as it does, not only more or less intricate problems, but such combinations with the ventilating system as to provide not only cooling, but ventilating as well, in accordance with the outside weather conditions. On account of the growing importance of this class of work, there is timeliness in the presentation of two comparative sets of calculations in detail, showing how the increased capacity of the theater will affect the size of apparatus required.

It might be said of the building to be taken as a basis for the following calculations that the first arrangement to be considered is an ordinary picture theater without a balcony, but with a sloping floor, and a stage sufficient for the accommodation of the screen only. For the second theater, the same building is considered, only a balcony is added which does not affect the heat requirements in the least but does increase the seating capacity, and, therefore, modifies the equipment to be installed so as to take care of the additional number of people. The second proposition also has a larger stage to permit a small amount of vaudeville to be presented at times, as well as moving pictures.

Fig. 1 gives the general floor plan of what hereafter will be termed the "picture theater" as distinguished from the second arrangement which will be termed the "vaudeville theater." It also should be stated that the theater is built up against adjacent buildings at certain places so that the wall losses will have to be calculated taking these conditions into consideration. Fig. 2 is a general cross section on the center line of the building.

HEAT LOSSES FOR THE PICTURE THEATER

The heat losses should be the first data calculated, and for this purpose there is nothing better than the Standard Heat Calculation Sheets as published by THE HEATING AND VENTILATING MAGAZINE, one of which is shown in Fig. 3. The wall and glass areas will be accepted as shown on this sheet, these having been scaled from the architectural drawings and, as such, will be used as the basis of all calculations for both theaters. It will be noted by referring to Fig. 3 that the factor used for the wall (which is 12-in. brick) is 16 B.T.U. per square feet for 70° F. temperature difference and 70 B.T.U. for glass with the same temperature rise. The exposures allowed were north 15%, west 10%, south none, and east 10%. Instead of figuring a hung ceiling with half the temperature rise for the assumed temperature between the hung ceiling and the roof (as is sometimes done), the loss through the roof slab was figured direct and for the full temperature difference, as it was found that the difference between this method and the other made very little difference in the results attained. Therefore the roof factor was taken as 42 B.T.U. per square foot for 70° F. temperature difference.

For the entrance, the doors were figured as glass, but, owing to the size and length of this entrance, only five air changes per hour were allowed. In the theater no air change was figured because it will be taken care of in the ventilation, to be explained later. The calculation sheet shows that with these assumptions the heat losses amount to

(1)	Theater proper	1,329,703 B.T.U.
	Entrance	154,840 B.T.U.
	Total	1,484,543 B.T.U.

This heat loss must be compensated for by radiation placed at various points about the theater, preferably in the lowest parts and with a proper proportion of the surface placed under the roof to prevent condensation. Assuming an efficiency of 240 B.T.U. per square foot for average radiator surface the theater would require a total of about 6185 sq. ft. of radiation, of which amount about 3300 sq. ft. would go under the roof and 600 sq. ft. in the entrance. Other smaller amounts would be distributed around the smaller rooms and corridors and the balance would have to be placed in the auditorium.

HEAT RADIATION FROM WALLS WHEN THEATER IS COOLED

When cooling is to be done in the theater it is generally best to calculate the cooling air required before the ventilation is considered, owing to the fact that the air required for cooling usually is so much in excess of that necessary for ventilation that any apparatus sufficient to accomplish the desired amount of cooling will be more than ample for ventilating.

In calculating cooling losses a lesser temperature difference, of course, is to be maintained. This usually is assumed to be 25° F., which means that the theater can be held at 70° F. when the outside temperature is at 95° F. or lower. If the outside temperature goes over 95° F., as sometimes happens in severe hot spells, then the theater temperature will be somewhat above 70° F., which is allowable to prevent too great a temperature change on excessively hot days.

Taking the same quantities for wall and glass and applying the factors for a 25° difference, instead of a 70° difference, the calculations will appear as shown in Fig. 4. It should be noted here that to be absolutely exact in calculating cooling losses there should be included all wall surface in the building which faces the outside or adjoins another building or room. In heating only, the exposed wall is considered, walls having a warmed room on the other side being neglected, as far as heat loss is concerned. In cooling calculations, however, there are no walls facing other uncooled rooms of buildings which will not radiate a certain amount of heat into the cooled theater so that all such wall actually should be figured in. For simplicity, in the calculations here presented, the same wall areas have been used and 2827 sq. ft. of additional wall simply have been added for unexposed surface to avoid confusion in purely a demonstration case.

Another point which may be noticed from Fig. 4 is that exposure additions are just reversed from those used for heat calculations. The north wall, being the coldest, requires the least amount of cooling, and the south wall, being the warmest, therefore requires the greatest amount of cooling. The calculations for cooling, including those for the walls, glass and roof, covering the heat which must be removed hourly, are as follows:

(2)	Theater proper	366,324 B.T.U.
	Entrance	17,836 B.T.U.
	Total	384,160 B.T.U.

Of the above B.T.U., the roof radiation consists of 154,000 B.T.U. and the walls, etc., constitute 230,000 B.T.U. in even figures.

HEAT SUPPLIED BY THE OCCUPANTS

By far the largest supply of heat which has to be removed from the theater by cooling is supplied by the people themselves. Some engineers allow only 350 B.T.U. per person per hour as the amount of heat added to the air in the theater, but actual laboratory tests indicate that 400 B.T.U. is more nearly an average figure, so 400 B.T.U. per hour will be used here. The actual seating capacity of the theater is about 2700 persons, so 3,000 persons were allowed for to provide for standees. Then the amount of heat emitted by the occupants would be

(3) 400 B.T.U. × 3,000 or 1,200,000 B.T.U.

HEAT FROM ELECTRIC LIGHTING

Another source of heat emission is the electric lighting but as there is very little light in a moving-picture theater, on the average, the mean current consumption was taken as about 3,000 watts per hour which is equivalent to

(4) 3.41 B.T.U. × 3,000 or about 10,000 B.T.U.

AMOUNT OF AIR REQUIRED BASED ON HEAT TO BE REMOVED

It is now possible to determine the total amount of heat to be removed from the theater by adding together the B.T.U. amounts so far calculated.

(5)	Walls and Entrance	230,000 B.T.U.
	Roof	154,000 B.T.U.
	Occupants	1,200,000 B.T.U.
	Electricity	10,000 B.T.U.
	Total	1,594,000 B.T.U.

As it is not permissible to put in air so cold as to cause annoyance from cold drafts, about 14° F. may be considered as the maximum amount of difference allowable between the incoming air temperature and the room temperature. And as 1 B.T.U. will raise 1 cu. ft. of air about 55° F. it will take only about ¼ B.T.U. to raise 1 cu. ft. of air 14° F., or, expressed in another way, it will take 4 cu. ft. of air raised 14° F. to absorb 1 B.T.U.

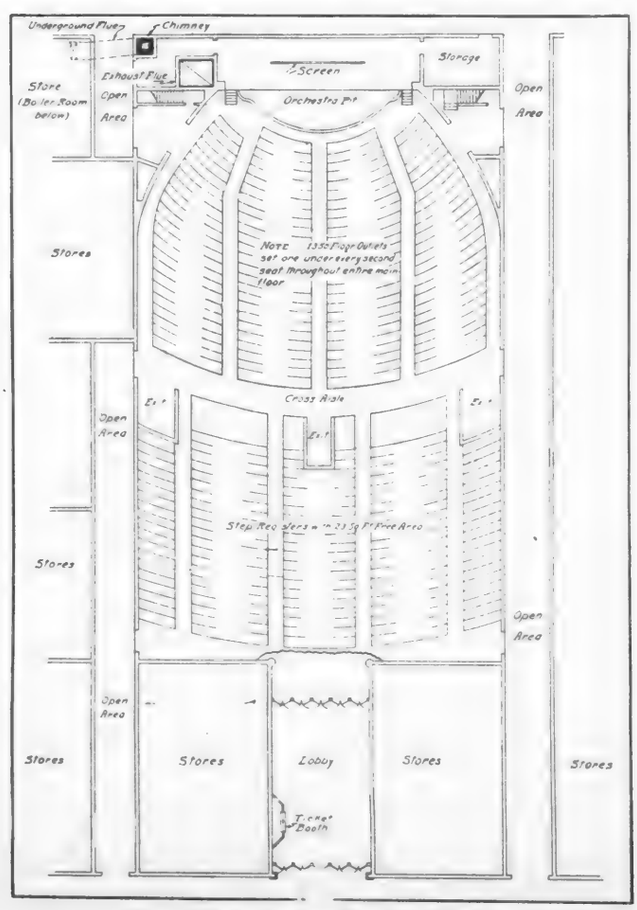


Fig. 1. Floor Plan of Picture Theater

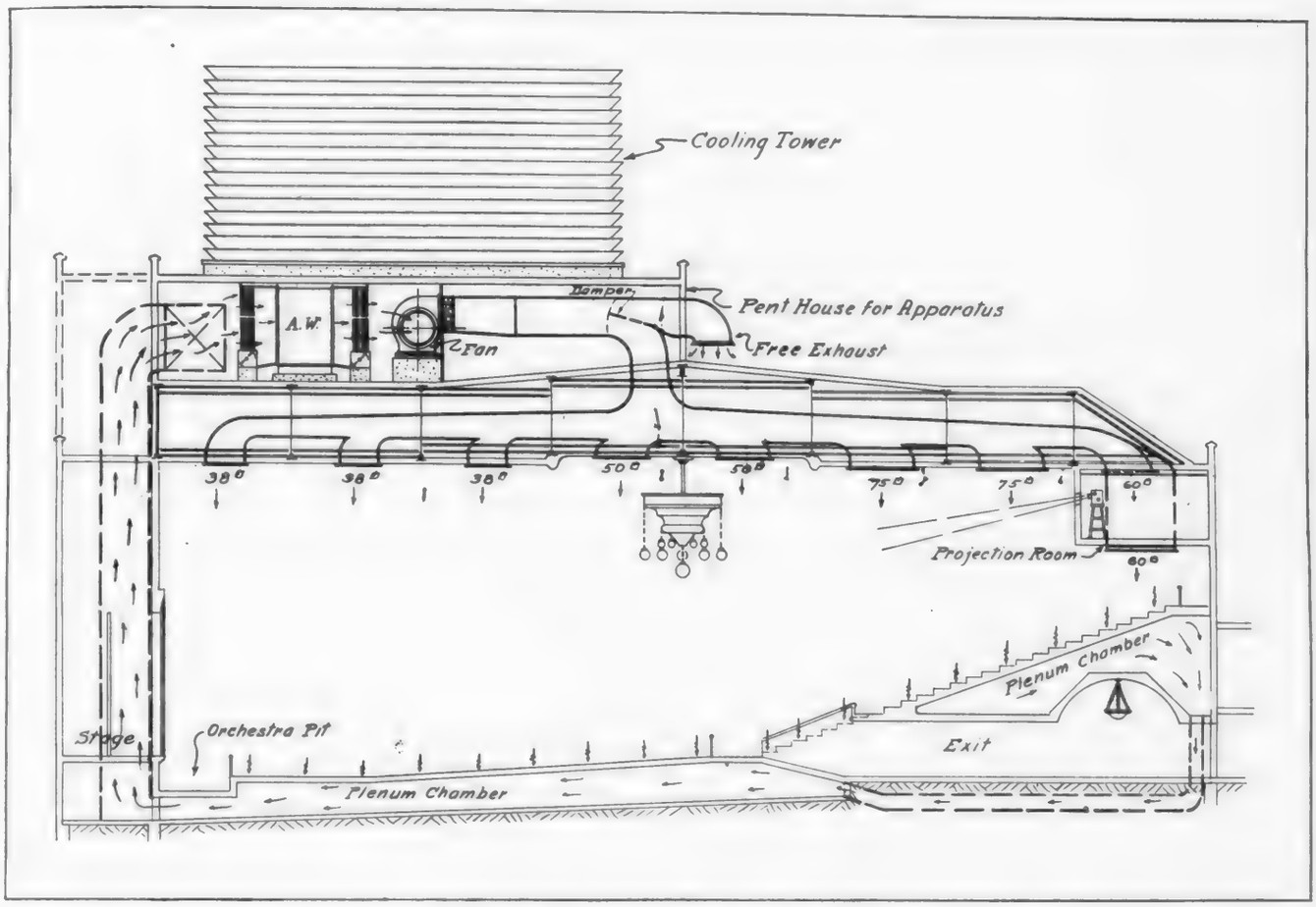


Fig. 2. Vertical Cross-Section of Picture Theater

Since there are some 1,594,000 B.T.U. to be carried off hourly the air required will be

(6) 1,594,000 × 4 equals 6,376,000 cu. ft. per hour which is 6,376,000/60 or 106,200 C.F.M.

Adding 10% for duct leakage and for a small factor of safety this amount becomes

(7) 6,376,000 plus 10% of 6,376,000, or 7,013,600 C.F.M.

Since this is an hourly quantity it must be divided by 60 to obtain the fan capacity which is

(8) 7,013,600/60 equals 116,900 C.F.M. *fan capacity.*

This 106,200 C.F.M. then is the quantity of air which must be delivered to the theater every minute by the fan at a temperature 14° lower than that desired in the theater in order to hold the temperature in the theater down to 70° F. when it is 95° F. outside. Compared to the number of occupants this is

(9) 106,200/3,000 or 35 plus cu. ft. per minute.

It will be seen that this is almost twice as much air as need be supplied for ventilation purposes only.

RECIRCULATION

In this theater the standard practice of recirculating 75% of the entire quantity of air furnished will be followed, and this means that the 25% of fresh air being used must be cooled from the maximum outside temperature down to the temperature at which it leaves the cooler, and that the condensation of the moisture in the air resulting from such cooling also must be taken care of. But the entire amount of fresh air does not go through the cooler as some 25% is by-passed around the outside in order to obtain the proper mixture and temperature before the entire quantity enters the fan. This is indicated in the arrangement of apparatus to be developed later.

Consequently there only needs to be considered about 75% of the fresh air used, as far as cooling and condensation from this cooling is concerned. While 116,900 C.F.M. (8) has been found to be the quantity of air at which the fan should be rated, the actual net quantity delivered to the theater is only 106,000 C.F.M. (6). Therefore, in figuring the amount of fresh air to be added it is not necessary to consider the duct leakage, or any additional factor of safety, but only to take the actual net amount of makeup air as required and based on the net amount of air theoretically necessary to cool the theater.

COOLING THE AIR

On this assumption the quantity of fresh air cooled from 95° F. down to the temperature of the air leaving the cooler (50° F.) is

(10) 25% of 106,000 or 26,500.

Then 75% of 26,500 C.F.M. must be reduced from 95° F. down to 50° F. or some 45° F. so that the number of B.T.U. given up will be

$$(10\text{-}1)\quad \frac{26{,}500 \times 60 \times (95 - 50)}{55} \times 75\% \text{ or}$$

976,600 B.T.U.

DEHUMIDIFYING THE AIR

In order to cool this amount of fresh air, there is a certain amount of water vapor which will have to be condensed and which will give off a predetermined amount of heat in condensing, just as steam gives off heat in condensing in a radiator. The amount of this vapor may be approximated by assuming an average outside humidity and determining the number of grains of water per cubic foot of fresh air as it is received from the outside. Then the number of grains contained in the saturated air leaving the cooler may be ascertained and the difference between the two amounts will be the number of grains per cubic foot that will be condensed in the cooler.

If the outside humidity is assumed as 50% when the outside temperature is 95° F., then the number of grains in each cubic foot is 8.56, and if the air leaving the cooler is assumed as at 50° F., and saturated, then the water necessary to be condensed and removed will be the difference between the number of grains per cubic foot, of the entering air (or 8.56 grains) and the cooled saturated air (or 4.07 grains), multiplied by the quantity of air passing through the cooler and divided by 7,000 grains to the pound, thus:

$$(11)\quad \frac{26{,}500 \times 60 \times (8.56 - 4.07)}{7{,}000} \times 75\%$$

equals 765 lbs.

This amount of water when condensing gives up about 1000 B.T.U. per pound so that multiplying the number of pounds by 1000 will show the number of B.T.U. necessary in the refrigeration to

STANDARD HEAT CALCULATION SHEETS

SHEET NO. 1
FLOOR Gill
BLDG. Theatre

JOB Picture Theatre — Vacuum — HEATING SYSTEM
LOCATION New York City
TEMPERATURE RISE 0° TO 70° = 70° DIFF.
DATE Sept 1 1927
ESTIMATED BY
CHECKED BY

Location of Losses / Description of Losses	Room No. THEATER Sq. Ft.	Thick Inches	B.T.U.	Room No. MAIN ENTRANCE Sq. Ft.	Thick Inches	B.T.U.	Room No.	Room No.
NORTH GROSS WALL	8795							
NORTH GLASS	160	70	11200					
NORTH NET WALL	1635	13"	148160					
NORTH TOTAL			144360					
NORTH EXPOSURE 15%			22464					
NORTH TOTAL			171,764					
WEST GROSS WALL	6048							
WEST GLASS	88	70	6160	392	70	27440		
WEST NET WALL	5960	13"	45360	—		—		
WEST TOTAL			101520			27440		
WEST EXPOSURE 10%			10152			2744		
WEST TOTAL			111702			30184		
SOUTH GROSS WALL	7307							
SOUTH GLASS	108	70	7560					
SOUTH NET WALL	7199	13"	115184					
SOUTH TOTAL			122744					
EAST GROSS WALL	4968							
EAST GLASS	462	70	32,340					
EAST NET WALL	4506	13"	72,096					
EAST TOTAL			104436					
EAST EXPOSURE 10%			10443					
EAST TOTAL			114879					
CEILING OR ROOF	19153	42	804626					
FLOOR								
—AIR CHANGE				7600	5A.C.	134656		
TOTAL								
GRAND TOTAL B.T.U.			1329703			154840		
RAD. EFFICIENCY								
RADIATION SURFACE THEORETICAL								
ACTUAL								

The Heating and Ventilating Magazine's Standard Data Sheets

Fig. 3. (Left) Heat Calculation Sheet for Picture Theater

STANDARD HEAT CALCULATION SHEETS

SHEET NO. 2
FLOOR Gill
BLDG. Theatre

JOB Picture Theatre — Cooling — HEATING SYSTEM
LOCATION New York City
TEMPERATURE RISE 95° TO 70° = 25° DIFF.
DATE Sept 1 1927
ESTIMATED BY
CHECKED BY

Location of Losses / Description of Losses	Room No. THEATER Sq. Ft.	Thick Inches	B.T.U.	Room No. MAIN ENTRANCE Sq. Ft.	Thick Inches	B.T.U.	Room No.	Room No.
NORTH GROSS WALL	10220							
NORTH GLASS	160	2.5	4000					
NORTH NET WALL	9060	12"	54360					
NORTH TOTAL			58360					
NORTH EXPOSURE 15%			NONE					
NORTH TOTAL			58360					
WEST GROSS WALL	6048							
WEST GLASS	88	25	2200	392	25	9800		
WEST NET WALL	5960	12"	35760			NONE		
WEST TOTAL			37960			9800		
WEST EXPOSURE 10%			3796			980		
WEST TOTAL			41756			10780		
SOUTH GROSS WALL	7307							
SOUTH GLASS	108	25	2700					
SOUTH NET WALL	7199	12"	43194					
SOUTH TOTAL Exp 15%			45894			52778		
EAST GROSS WALL	4968							
EAST GLASS	462	25	11550					
EAST NET WALL	4506	12"	27036					
EAST TOTAL			38586					
EAST EXPOSURE 10%			3859					
EAST TOTAL			42445					
CEILING OR ROOF	19253	8	154024	336	15	5040		
FLOOR								
—AIR CHANGE								
Smooth Wall	2807	1/6	16962	336	12"	2016		
TOTAL			16962			2016		
GRAND TOTAL B.T.U.			363246			17,836		
RAD. EFFICIENCY								
RADIATION SURFACE THEORETICAL								
ACTUAL								

The Heating and Ventilating Magazine's Standard Data Sheets

Fig. 4. (Right) Cooling Calculation Sheet for Picture Theater

absorb the amount of heat produced by this amount of condensation.

(12) 765 × 1,000 equals 765,000 B.T.U. for dehumidifying.

The reason that the temperature for the air leaving the cooler is assumed as 50° F. can be seen by the following:

If the temperature of the air in the theater is to be maintained at 70° F., and the recirculation air is to be taken from the theater, then the temperature of the recirculation air also will be 70° F.; and, if the maximum temperature of the outside air is assumed as 95° F., then the makeup of fresh air also will be at 95° F. Now the recirculation air constitutes 75% of the air supply and the makeup 25%, so a mixture of these two quantities will produce a resultant temperature of

$$(12\text{-}1)\quad \frac{25\% \times 95^\circ \text{ plus } 75\% \times 70^\circ}{100\%} \text{ or } 76\tfrac{1}{4}^\circ \text{ F.}$$

This, then, is the temperature of the incoming mixture before any of it passes through the cooler. After passing through the cooler, the air going to the theater must have a temperature of 14° less than the theater temperature of 70° F., because this rise of 14° is the amount on which the quantity of air to be supplied was based. The air leaving the cooler then will have the temperature of

(12-2) 70° — 14° or 56° F.

To produce this final temperature of 56° F., with 75% of the air going through the cooler and 25% by-passing the cooler and having the temperature of the air by-passing the cooler already determined on as 76¼° F., the cooler temperature may be ascertained by the following, with "X" representing the final cooler temperature:

$$(12\text{-}3)\quad \frac{25\% \times 76\tfrac{1}{4}^\circ \text{ plus } 75\% \text{ of } \text{"X"}^\circ}{100\%} \text{ equals } 56^\circ \text{ F.}$$

and, solving, it is found that

(12-4) "X" equals 50° F. (approx.)

Now, out of the 106,000 C.F.M. being supplied to the theater 75%, or 80,000 C.F.M., is being recirculated, and 25%, or 26,000 C.F.M., is being supplied from outside. When this recirculated air and fresh air intermix the above figures may be proved in the concrete application by the following:

(13) 80,000 × 70° equals 5,600,000° ft.
26,000 × 95° equals 2,470,000° ft.

106,000 8,070,000° ft.

8,070,000° ft. / 106,000 ft. equals 76° F. (plus),

and the mixture after passing the cooler will have a final temperature of

(14) 80,000 × 50° equals 4,000,000° ft.
26,000 × 76° equals 1,976,000° ft.

106,000 5,976,000° ft.

5,976,000° ft. / 106,000 ft. equals 56° F. plus.

As this is the 14° less than the theater temperature of 70° F. desired, it shows that the calculations and assumptions for temperatures are correct. The air now will enter the theater at 56° F., will be warmed in the theater up to 70° F., will pass out of the exhaust outlets and up through the recirculation duct to where the makeup at 95° F. enters and mixes with it, producing a resulting temperature of 76° F., and will have a portion pass through the cooler and a portion pass around the cooler, giving a final mixture temperature of 56° F., from which it enters the theater and repeats the cycle.

ADDITIONAL DEHUMIDIFICATION DUE TO RESPIRATION

In exhaled breath there is a certain amount of moisture given off which goes into the air and helps to raise the moisture content. In recirculating, this moisture — or at least 75% of it — goes back in the recirculation air and must be removed from this air by dehumidifying; the other 25% is lost with the air that leaks out of the building and, therefore, need not be considered. The amount of this moisture is about 0.106 lbs. per hour per person so that for 3,000 persons the latent heat of the moisture added to the recirculation air will be

(15) 3,000 × 0.106 × 1,000 B.T.U. × 75% or 238,000 B.T.U.

The total amount of heat absorbed in the refrigeration plant now may be calculated by adding all the various sources of heat emission and by a sufficient additional allowance to take care of the condensation release of the latent heat of evaporation.

Next month's installment will take up the design of a refrigeration plant for the theater under discussion, together with a method for calculating the size of the cooling tower and the cooling tower pumps. The author will also present a comparative study based on the use of cast-iron and lightweight heaters, together with other points connected with the design.

Deterioration of Radiator Nipples

IN a group of buildings supplied by a central heating plant the one-pipe radiation is installed with horizontal connections through globe valves. This leaves the lower part of the bottom push-nipples always submerged in water up to the valve port. Apparently, this condition leads to electrolytic action between the malleable nipple and the cast-iron. The upper part of the nipple down to the line of submersion remains in perfect condition. Below this point the nipple is eaten away quite uniformly. When washed off the metal is bright, having the appearance of being etched with acid.

Radiators springing leaks are being renippled with brass push-nipples which, from experience with C. I. valves, brass trimmed or fitted, should overcome the trouble.

Design of Lumber Dry Kilns

Part IV

CONSIDERABLE attention has been devoted to kiln drying of lumber by the New York State College of Forestry, at Syracuse University, and the results of its studies have been placed before the public in Bulletin No. 16. In this bulletin the general practice of dividing all lumber dry kilns into two classes—the progressive and the compartment types—has been followed. In the progressive kiln the green, or entering end, is warm and humid, and the dry, or leaving end, is hot and dry. Lumber enters at the warm, humid end and moves gradually toward the hotter and less humid space until the leaving end is reached. By this progressive process, from day to day, the lumber experiences all the necessary drying effects of heat and humidity by passing through the areas where these conditions exist. The varying conditions are produced in the same kiln by having a current of air continuously passing from the hot, dry end toward the entering end, the moisture picked up by the air resulting in both humidifying and cooling it. In this type of kiln part of the air goes out of stacks at the entering end of the kiln; the remainder is recirculated.

To obtain the proper drop in temperature and corresponding rise in humidity the kiln must be of a certain length; experience has shown that the length must be at least 100 ft. and greater lengths are recommended.

COMPARTMENT KILNS

In the compartment kiln the air conditions practically are the same in all parts of the kiln at the same time; the lumber is stacked in one position and remains in that position until the drying process is completed. The various conditions necessary for proper drying are obtained by varying the air in the entire compartment as the drying progresses, the lumber being first subjected to warm, humid air until it has dried sufficiently to permit the use of dryer air of higher temperature. This increase in temperature and decrease in humidity continues until the lumber has reached the final stage of drying, at which time it is removed from the kiln and a new charge of green lumber substituted when the process is repeated.

A majority of the kilns now in use are of the ventilated compartment type and it is rather confusing to the uninitiated to find that many kilns, while diametrically opposed to each other in method of operation, can arrive at the finish with quite similar results. To understand the basic principles of kiln operation a few fundamental facts must be kept in mind. In the first place, heat almost invariably is furnished by steam contained in coils or radiators located in the lower portion of the kiln beneath the lumber, and air is the universal agent which transports the heat from the heating elements to the lumber. The expansion of the air when it becomes heated causes it to rise up through the piles of lumber, picking up the moisture in its travel.

PROPER HUMIDITY CONDITIONS MUST BE PROVIDED

The relative humidity of the air is maintained at the proper point by introducing steam into the air through steam sprays or jet blowers which mix the steam with the air. Owing to the fact that the vapor weight is less than that of the air, the use of steam sprays assists the circulation by making the air lighter. While in some kilns the air rises up through the piles of lumber, in others the upward circulation is at the sides and the air flows down through the lumber. The moisture evaporated from the lumber enters the air and would make this air still more buoyant were it not for the fact

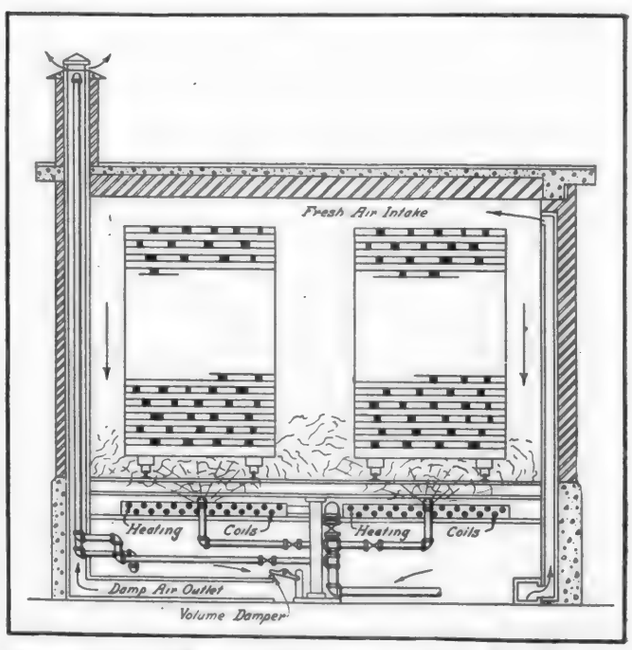


Fig. 1. Typical Design of Compartment Kiln Providing for Admission of Fresh Air at One Side Near Top and Removal of Cool, Moist Air at Bottom

that the moisture evaporation also cools the air to such a degree that the lightening effect of evaporation is more than counterbalanced.

Stacks or chimneys are provided to carry away the moist air from the kiln, and fresh air is drawn in to replace it; the fresh air, being dry and cool, is mixed with some of the recirculated air and humidified to the point desired at that particular portion of the drying process and the drying is continued.

The best design of heating element is the one which gives the best distribution of heat over the

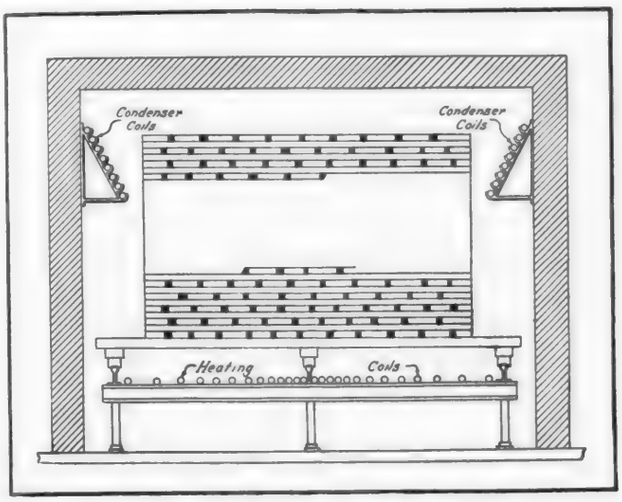


Fig. 2. Condenser Kiln Showing Condenser Coils High Up on Side Walls

entire portion of the kiln. For this reason the heating element often is divided into units, not only to provide better distribution but also better control.

In the dry kiln shown in Fig. 1 the fresh air is admitted at one side near the top and the cooled moist air is removed from the bottom and passes up through a vent stack in which an aspirating coil is placed.

CONDENSER KILNS

Another style of kiln, known as a condenser kiln, is shown in Fig. 2. In these kilns the moisture is removed by condensing it, and the air is recirculated without any fresh air being added. The condenser coils are those shown high up on the side walls and their condensing effect is obtained by circulating cold water through the pipes. The cooling effect of these pipes, combined with the heating effect of the coils beneath the lumber, produces the necessary air circulation and the relative humidity is controlled by the amount of cold water so circulated.

PROGRESSIVE KILNS

As previously stated, the minimum length of a progressive kiln should be not less than 100 ft., but there is little advantage in making the length over 175 ft., and kilns lying between these two limiting dimensions have proved to give the greatest satisfaction. Best practice demands that the air be circulated lengthwise in a progressive kiln and that the lumber should be piled crosswise. Lengthwise piling is claimed to retard the air movement and, while vertical piling is sometimes employed, the loss from warping, twisting and splitting is very high.

Progressive kilns always have doors at both ends, for inserting green lumber at the entering end and for removing the dried lumber from the leaving end. To facilitate handling it is customary to have small track yards at each end of the kiln on the outside so that a certain amount of both green and dried lumber can be stored just before entering or just after leaving the kiln. A layout for a typical progressive dry kiln is shown in Fig. 3, and it will be noted that this is a six-section kiln—that is to say, it really is six progressive kilns built together.

The two middle sections, as well as the two on the right, are shown completely filled with lumber trucks and it will be noted that a total of sixteen may be accommodated. In another section no trucks are indicated, which shows that no drying is being carried on in that particular section. The section on the extreme left shows trucks partially filling the space, indicating a condition for a charge of lumber which has progressed about half through the drying process.

TEMPERATURE REQUIRED FOR DRYING

Different woods require different treatment in drying and different thicknesses also make a further variation. Assuming all lumber to be steamed at the start for a period of 1 hr. per inch for green and 2 hrs. per inch if air dried, the following schedule will give good results:

Material	Temperature—Entering	Temperature—Leaving
Basswood Birch Yellow poplar Chestnut Black ash Sap gum	145° F. increasing to 175° F.	

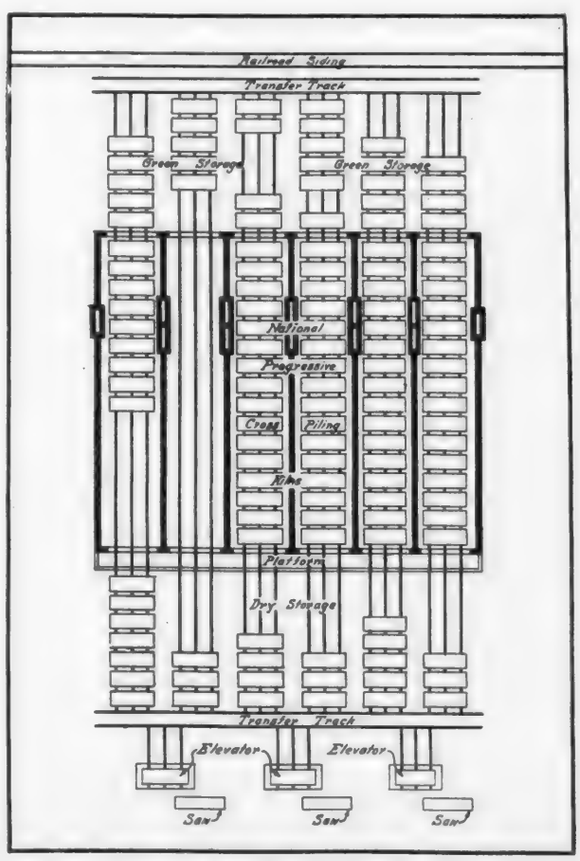


Fig. 3. Six-Section Progressive Dry Kiln

Maple, White ash, Elm, Butternut, Cherry, Beech	130° F. increasing to 165° F.
Red oak, Mahogany, Red gum, Black gum	
Sycamore, Walnut, Hickory, White oak, Other hard and heavy woods	120° F. increasing to 155° F.

In the first group where the drying temperatures are kept from 145° to 175° F. (dry-bulb) the wet-bulb temperature is held at a constant of 133° F. all through the drying process which gives relative humidities ranging from 70% at 145° down to 32% at 175° F.

In the second group where the (dry-bulb) temperatures run from 130° to 165° F., the wet-bulb is held constantly at 120° F., giving relative humidities ranging from 74%, at the beginning of the drying, down to 27% at the completion of the process.

In the third group, where temperatures vary from 120° to 155° F., (dry-bulb) the wet-bulb is kept at 103° F. and the corresponding relative humidities range from 80% down to 27%.

Testing the Efficiency of Gas-Fired Warm-Air Furnaces

(*Continued from Page 66*)

rent required. Corrections for the humidity of the air can be made if desired. The weight of water vapor is less than that of air but its specific heat is more, the product of these factors being almost the same for both air and water vapor. Since the problem is concerned with the heat capacity of the air rather than its actual weight, sufficiently accurate results will be obtained if the humidity correction is omitted.

The hourly heat-output from the furnace is calculated by multiplying the rate of air flow in pounds per hour by its specific heat and by the temperature rise. Efficiencies are calculated as a percentage of the hourly gross heat-input of the gas.

The method outlined above has the virtue of simplicity and rapidity. Check tests can be made in short periods of time, and these checks have proved sufficiently accurate for the purpose of such tests as are made to determine furnace ratings.

It is obvious that the foregoing method can be applied to the testing of oil-fired furnaces, where the heat-input rate can be maintained constant and quantitatively determined.

New Home-Study Course in Gravity Steam and Water Heating

Lesson No. 26 (*Concluded*)

Ratings of Steam and Water Boilers

WHEN the number of gallons of water which must be heated in a given time is known, the rating of a hot water heater may be estimated as follows:

First: Determine and note the number of gallons of water to be heated. In the case of a hot water heating system, the total value of water in the system must be calculated and increased by as many times as complete circulation occurs per hour. (See Table R-1-8 with Lesson No. 13 (R-1) published in THE HEATING AND VENTILATING MAGAZINE, for December, 1925, for calculating total capacity of the system).

Second: Multiply result First by 8½ (lbs. per gal.) and obtain the total weight of water to be heated.

Third: Divide result Second by the number of hours in which the heating is to be accomplished and obtain the weight of water to be heated per hour.

Fourth: Subtract the initial temperature of the water from the final temperature and obtain the degree temperature rise.

Fifth: Multiply result Third by result Fourth and obtain total B.T.U. to be supplied per hour.

Sixth: Divide result Fifth by 150 and obtain a boiler rating for water heating in terms of sq. ft. of direct standing cast-iron radiation.

Work Problem B-3-12

CHECKING GRATE SURFACE

It is always advisable to check the suitability of a boiler by calculating the grate area required. If the heat loss from a building has been computed by the B.T.U. method (see Lesson 3, THE HEATING AND VENTILATING MAGAZINE, for January, 1925), the heat to be supplied is known more accurately so that by checking the grate area, boiler selection is placed on a more firm basis.

The total heat loss must include, in addition to the calculated losses, the heat given off from the piping system and boiler.

Required grate area may be determined as follows:

First: Multiply B.T.U. loss from the building by 1.25 or 1.50 depending on relative proportion of piping to radiator area and get the total heat requirement.

Second: Assume a rate of combustion suited to conditions. See Table B-1-1 with Lesson No. 24, THE HEATING AND VENTILATING MAGAZINE, for June, 1927.

Third: Select a heat value for the fuel as B.T.U. per 1 lb.

Fourth: Assume a value for combined efficiency of boiler and grate.

Fifth: Obtain product of results Second × Third × Fourth.

Sixth: Divide result First by result Fifth and obtain the area of grate in square feet required for the existing conditions.

Work Problems B-3-13, B-3-14

EFFECT OF FUELS ON RATINGS

Since the majority of the tables for boiler ratings found in the various catalogs of manufacturers are based on the use of anthracite coal, of stove size, the effect of using other size or kind of coal must be taken into consideration where anthracite is not to be used or where it may be desirable to change the kind and grade of fuel.

Bituminous coal occupies about 25% more space than the same weight of anthracite which, if used, demands the selection of a boiler having at least 25% greater capacity. Also, if soft coal is to be used, additional boiler heating surface is required, since the accumulation of soot from such coal renders the heating surface less effective than when hard coal is used.

Since the smaller sizes of anthracite are likely to contain more ash than the larger sizes, and hence have a greater bulk for the same heating effect, the use of pea, buckwheat and chestnut sizes may make it advisable to provide a larger fuel pot. See Lesson B-1, THE HEATING AND VENTILATING MAGAZINE, for June, 1927, for determining sizes of fuel pot.

DOMESTIC HOT-WATER REQUIREMENTS

Hot water requirements differ for almost every residence. The number of persons, their habits, etc., determine the total hot water demand. No hard and fast rule can be stated by which exact demands can be foretold. The heating unit, however, should be capable of heating ample water to meet peak conditions. Generally speaking, an allowance of 7 gal. per person per hour with a reserve of approximately 50%, is a safe figure. If washing machines and extra lavatories are installed, a greater amount can safely be allowed. Tank capacities should be the nearest standard above the 150% estimated.

TABLE B-3-2. HOT WATER REQUIREMENTS (APPROXIMATE)

No. Persons	Gal. Water per Hour (Max.)	Tank Capacity (Gal.)
2	14	30
3	21	32
4	28	40
5	35	52
6	42	66
7	49	82
8	56	82
9	63	100
10	70	100

Accurate rules for determining increased demands on the boiler are difficult to express since there are so many variable factors to consider.

Some estimate, nevertheless, always should be made, and the effect of this additional demand for heat upon boiler capacity required should be considered when making the selection.

When a pipe coil is in contact with a good fire, there may be expected a heat transmission of about 15,000 B.T.U. per sq. ft. per hr.

On this basis, if water be raised in temperature from 50° to 150° F. or through 100° F., every square foot of coil will heat about 18 gal. of water per hour. Common practice allows 15 gal. per sq. ft. of submerged coil.

When the coil is placed above the fire, the heat transmission materially is reduced, depending upon the intensity of the fire.

LENGTH OF COILS REQUIRED

The length of coil required for a given installation frequently is needed. Table B-3-3 contains lengths expressed in feet for four different sizes of pipe.

Calculations on the basis of 10 gal. per hr. are as follows:

Transmission rate (coils in contact with fire) = 15,000 B.T.U. per hr.

Water heated from 50° to 150° F.

Weight of water heated = 10 (gal.) × 8.3 (lbs.) = 83.33 lb.

B.T.U. required = 83.33 (lb.) × 100 (tem. diff.) = 8333 B.T.U. per hr.

$$\text{Sq. ft. of surface required} = \frac{8333}{15{,}000} = 0.55 \text{ sq. ft.}$$

Lineal feet of 1-in. pipe = 0.55 ÷ 0.344 = 1.45 ft.
1¼-in. pipe = 0.55 ÷ 0.435 = 1.15 ft.
1½-in. pipe = 0.55 ÷ 0.498 = 1.00 ft.
2-in. pipe = 0.55 ÷ 0.622 = 0.80 ft.

Reduction of 25% to allow for ashes, etc.

To heat 10 gal. of water per hour requires
1.10 ft. of 1-in. pipe.
0.86 ft. of 1¼-in. pipe.
0.75 ft. of 1½-in. pipe.
0.60 ft. of 2-in. pipe.

TABLE B-3-3. LENGTHS OF COILS REQUIRED IN FIRE BOX FOR HEATING DOMESTIC WATER SUPPLY

Water Heated, Gal. per Hour	Nominal Pipe Size			
	1 In.	1¼ In.	1½ In.	2 In.
	Length of Pipe in Feet			
10	1.10	0.86	0.75	0.60
15	1.65	1.29	1.12	0.90
20	2.20	1.72	1.50	1.20
25	2.75	2.15	1.88	1.50
30	3.30	2.58	2.25	1.80
35	3.85	3.00	2.62	2.10
40	4.40	3.45	3.00	2.40
45	4.95	3.86	3.36	2.70
50	5.50	4.30	3.75	3.00

If the pipe coil is above the fire and therefore not in direct contact therewith, the heat transmission materially will be less. Thus, for warm-air heater installations, the above lengths properly may be increased 50% for the respective capacities.

This is the twenty-seventh lesson of The Heating and Ventilating Magazine's

New Home-Study Course in Gravity Steam and Water Heating

Lesson No. 27—Steam and Water Boilers*

By Ara Marcus Daniels

EFFICIENCY is a term often loosely used in connection with boiler operation. A boiler may be highly efficient, but the term is meaningless without a definition of the conditions under which the efficiency was determined. The efficiency of a boiler is not that of a heating system in which it may be used; a boiler of high efficiency may be incorporated in a heating plant that, due to no fault of the boiler, may be very inefficient.

The student should appreciate fully that boiler efficiency and the efficiency of a heating system are two totally different things. True, an efficient boiler contributes its share toward an efficient heating system, yet the most efficient boiler, in itself, cannot assure a high over-all efficiency of the entire heating plant.

BOILER EFFICIENCY

If there is burned, in a boiler, in one hour, 20 lbs. of a certain coal, containing 12,500 B.T.U. per pound, the total heat energy made available is $20 \times 12{,}500 = 250{,}000$ B.T.U.

If a test made, while burning this coal at a uniform rate, shows that, during the hour, there has been delivered to the water in the boiler 140,000 B.T.U., then $140{,}000 \div 250{,}000 = 0.58$, which is the decimal part of unity representing the output of the boiler divided by its input; it is the ratio of energy utilized to energy expended. Multiplying this decimal by 100 converts the ratio to percentage, and the efficiency of the boiler, as shown by the test just cited, would be 58%.

Such a figure can be obtained for any boiler, when arrangements are made to secure the necessary readings, and when the conditions under which the boiler operates can be controlled and maintained constant.

To say that a boiler will operate at a stated efficiency as part of a heating system is to assume that all conditions, at all times, under such operation, are identical with those occurring under the test conditions when the stated value for efficiency was established.

Too much emphasis, therefore, cannot be laid upon the fact that the efficiency of a boiler can be stated only *for a definite load and under specific conditions of operation.* A boiler operating under a fluctuating load would have a corresponding fluctuating efficiency, and variations other than the load, such as changes in climatic conditions, change in feed-water temperature, and so on, would again change the output-input ratio.

Boiler efficiency, therefore, should not be regarded as a fixed quantity, for, indeed, it is different with varying conditions. It is practically impos-

DATA REQUIRED FOR PREPARING HEAT BALANCE

	TEMPERATURES	
t_a	AIR TEMPERATURE, DRY BULB	70°F.
	WET BULB	65°F.
t_f	TEMPERATURE OF FUEL AS FIRED	70°F.
T	TEMPERATURE OF FLUE GASES	645°F.
	ULTIMATE ANALYSIS	
C	CARBON, PER CENT	79.50
H_2	HYDROGEN, PER CENT	2.43
O_2	OXYGEN, PER CENT	1.68
N_2	NITROGEN, PER CENT	0.75
S	SULPHUR, PER CENT	0.81
	MOISTURE IN FUEL, PER CENT	1.44
M	, LB. PER LB. FUEL	0.0144
	ASH, PER CENT	13.39
	FLUE GAS ANALYSIS	
CO_2	CARBON DIOXIDE, PER CENT	17.2
O_2	OXYGEN, PER CENT	2.3
CO	CARBON MONOXIDE, PER CENT	0.0
N_2	NITROGEN, PER CENT, BY DIFFERENCE	80.5
	BY ANALYSIS	
s	ASH AND REFUSE, PER CENT DRY COAL	6.97
S	UNCONSUMED CARBON IN ASH, PER CENT	27.54
	HEAT VALUE OF FUEL	
H	B.T.U. PER LB DRY COAL	12790

Fig. B-4-1. Fundamental Information Necessary for Computing Heat Balance

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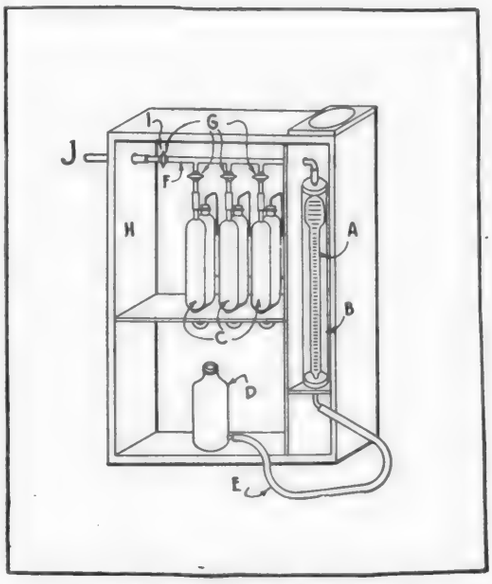

Fig. B-4-2. Orsat Apparatus

sible to say that a draft of a certain intensity will be developed in a certain chimney. And variations in draft are important in influencing boiler efficiency. To say that a boiler of certain make, or design, will develop an efficiency of 50%, 60%, 70% or 80% is to give the impression that boiler efficiency is an inherent part of the boiler, when, as explained, operating conditions, in large measure, control boiler efficiency.

Every boiler has an "efficiency curve." To obtain this curve for a given boiler, it is necessary to make a series of tests at different rates of combustion. During such tests many data are taken, from which may be calculated the quantities and rates of energy utilized and wasted.

HEAT LOSSES

The losses of heat which occur during a boiler test (and when the boiler is in operation, in service) may be enumerated as follows:

(1) Losses up the chimney.
(2) Loss through the grate, if coal is the fuel.
(3) Loss due to radiation of heat from the boiler shell.
(4) Loss due to combustion of only part of the fuel.
(5) Loss due to moisture in the air used for combustion.
(6) Loss due to convection currents, and unaccounted losses.

Since losses (3) to (6), inclusive, are relatively small, especially those designated as (4) to (6), inclusive, these last four frequently are included under one heading and are listed as "radiation and other losses."

Heat lost up the chimney represents, by far, the greatest part of the heat that is not usefully employed. The products of combustion pass up the chimney. In order that there may be a movement of air through the boiler and chimney it is necessary that the temperature of air or gases in the boiler and stack is higher than the temperature of the outside air surrounding the chimney. Thus, since draft action is necessary for the operation of a boiler, a portion of the heat escaping through the chimney really does useful work, and is not an unnecessary loss. The total heat carried up the chimney usually is much greater than is necessary for draft purposes, and represents an operating loss.

Chimney losses are of two kinds, (a) unconsumed combustible in the fuel, such as soot and gases which are not completely oxidized which, if completely burned, would give off additional heat, and (b) excess heat actually wasted in the chimney gases.

Under certain conditions the soot and unburned gas loss may be high. If too much air is fed to the fire it may reduce the temperature in portions of the combustion chamber to less than the ignition temperature of some of the combustibles and thereby prevent complete combustion. If too little air is admitted, there will not be enough oxygen to permit complete combustion of the fuel. Thin fires (in the case of coal), holes through the fire bed, open fire-doors and open joints frequently result in too much air being admitted. Firing too much coal at one time increases the resistance through the fire and decreases the air flow.

GRATE AND ASH-PIT LOSSES

Grate and ash-pit losses, naturally, apply to coal-burning plants and are largely due to excessive and too-frequent shaking. Whenever unburned or partially-burned coal passes through the grates with the ashes, this loss occurs. Improper size openings in or between the grate bars, for the size or kind of coal used, may cause this loss to be abnormally high.

RADIATION AND OTHER LOSSES

While heat radiated from an uninsulated boiler may be considered as useful in heating the base-

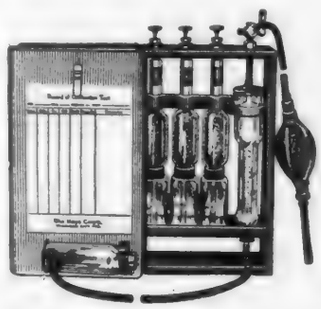

Fig. B-4-3. Portable Type Orsat Apparatus

ment, and thus assist in providing a warmer floor above, it must be considered as a loss when computing boiler efficiency, as it is not delivered at the boiler outlet for controlled distribution. As a practical matter boilers usually are lagged with an in-

sulated cover; much depends upon the location of the boiler and the possibility of utilizing this radiated heat. Always, in computing boiler efficiency, radiation and convection losses are real and included in the "loss" column.

Other losses usually "lumped" with the radiation loss are the heat required to evaporate any moisture that may be present in the air used for combustion and the latent heat of the water formed from combustion of the hydrogen in the fuel.

When boiler tests are conducted, provision is made for taking the necessary readings from which may be determined how all the heat in the fuel is expended. From these readings, and knowing the analysis of the fuel, a heat balance may be prepared.

HEAT BALANCES

A heat balance may be prepared on the basis of 1 lb. of fuel. The quantities are expressed in one or both of two ways.

(a) Heat balance, per pound fuel as fired.
(b) Heat balance, per cent heat in fuel as fired.

Previous to the preparation of a heat balance, three things must be done:

(1) An ultimate analysis of the fuel is made and its heat value in B.T.U. per pound determined.
(2) A test is conducted with the boiler, using the particular fuel.
(3) Computations of all losses are made and a distribution of the heat evolved from the combustion of the fuel is determined.

An example showing the data required, as obtained from a test of a coal-burning boiler, is shown in Fig. B-4-1.

Temperatures are obtained with suitable thermometers. The ultimate analysis of the fuel must be made in a laboratory equipped for such work. Fuel samples are taken in a duly prescribed manner during the test, sealed and forwarded to the laboratory.

The flue gases are analyzed from samples taken from the smoke pipe just after the gases have passed the last heat-absorbing part of the boiler. Such samples often are gathered at stated intervals during the test and analyzed at once. A sample taken in this way is called a "grab" sample, requires but a few seconds to secure, and serves to indicate conditions at the time and place where the sample is collected. When conditions justify, it is better to use continuously selected samples which are collected during several hours. Naturally, such are more representative than those "grabbed" and often are to be preferred when the composition of the gases determined therefrom are to be used as the basis for a report on operation. The average values from a number of samples taken and analyzed at frequent intervals during the test, however, usually may be taken as indicative of conditions.

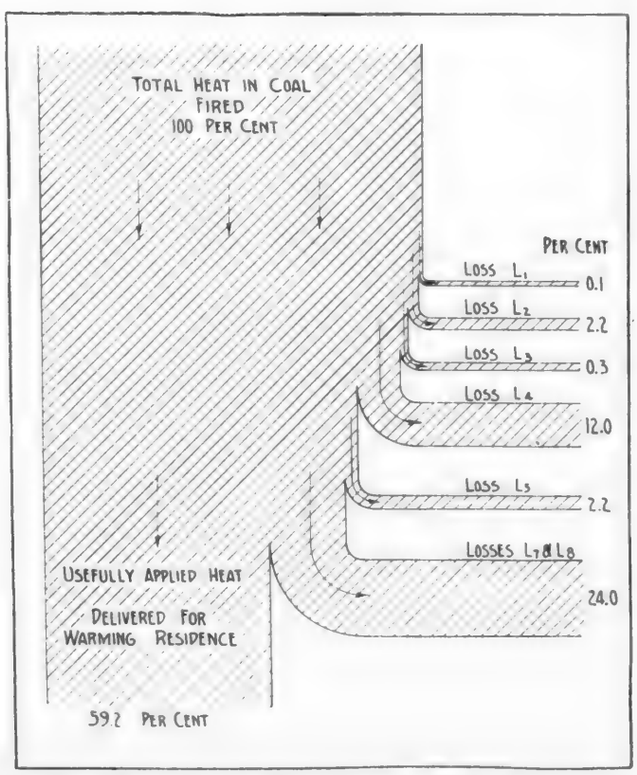

Fig. B-4-4. Graphic Representation of Heat Distribution

HEAT BALANCE
PER LB. FUEL AS FIRED

SYMBOL	QUANTITIES	B.T.U.	PER CENT
L_1	LOSS DUE TO MOISTURE IN THE FUEL	19	0.1
L_2	LOSS DUE TO BURNING HYDROGEN OF THE FUEL	287	2.2
L_3	LOSS DUE TO MOISTURE IN AIR USED FOR COMBUSTION	36	0.3
L_4	LOSS IN DRY CHIMNEY GASES	1532	12.0
L_5	LOSS DUE TO UNCONSUMED COMBUSTIBLE IN ASH AND REFUSE	280	2.2
L_6	LOSS DUE TO UNCONSUMED GASEOUS COMBUSTIBLE MATTER	0	0.0
L_7	LOSS DUE TO RADIATION FROM HEATER	3069	24.0
L_8	LOSS DUE TO CONVECTION AND UNACCOUNTED FOR LOSSES		
	USEFULLY APPLIED HEAT	7567	59.2
	B.T.U. PER LB. OF FUEL	12790	100.0

Table B-4-1

Analysis of flue gases is made with an Orsat apparatus. A typical instrument is illustrated in Fig. B-4-2 while a portable type with half-size burette is shown as Fig. B-4-3.

The instrument consists essentially of a measuring burette A, a water-jacket glass cylinder B, three absorption pipettes, C, a leveling bottle D, connecting rubber tubing E, a glass header F, ground-glass stop cocks G, and a case H for enclosing the apparatus. The stop cock marked I is a 3-way stop cock so that gas may pass into the header from tube J or may be discharged to the atmosphere from the header through an opening (not shown) on the rear side.

The measuring burette A is of cylindrical glass, graduated in 100 units, with each unit divided into five parts. Orsat apparatus are built full and half size. The burette of a full-size Orsat has a volume of 100 cubic centimeters (100 c.c.) while the volume of the half-size burette is 50 c.c.

The water-jacketing cylinder B is rubber stoppered at the top and bottom and completely en-

HEAT BALANCES
DATA FROM TESTS USING ANTHRACITE COAL

SYMBOL	QUANTITIES	B.T.U. PER POUND OF FUEL AS FIRED			PER CENT HEAT IN FUEL AS FIRED		
		A	B	C	A	B	C
L_1	LOSS DUE TO MOISTURE IN THE FUEL	38	36	33	0.3	0.3	0.3
L_2	LOSS DUE TO BURNING HYDROGEN OF THE FUEL	354	340	312	2.8	2.6	2.4
L_3	LOSS DUE TO MOISTURE IN AIR USED FOR COMBUSTION	53	20	22	0.4	0.2	0.2
L_4	LOSS IN DRY CHIMNEY GASES	2543	2025	1106	19.8	15.7	8.6
L_5	LOSS DUE TO UNCONSUMED COMBUSTIBLE IN ASH AND REFUSE	633	200	345	4.9	1.6	2.7
L_6	LOSS DUE TO UNCONSUMED GASEOUS COMBUSTIBLE MATTER	238	0	0	1.8	0.0	0.0
L_7	LOSS DUE TO RADIATION FROM HEATER	326	310	419	2.5	2.4	3.3
L_8	LOSS DUE TO CONVECTION AND UNACCOUNTED FOR LOSSES	2437	3167	492	19.0	22.2	3.7
	USEFULLY APPLIED HEAT	6248	7082	10141	48.5	55.0	78.8
	B.T.U. PER LB. OF FUEL	12870	12870	12870	100.0	100.0	100.0

Table B-4-2

closes the burette A in a water bath so as to maintain the gas at practically a constant temperature during analysis.

The absorption pipettes C are U-shaped glass vessels about 1¼ in. in diameter with the connecting U at the bottom of about ⅜-in. glass tubing. The front arm of the pipette is filled with nested glass tubes with top and bottom open so as to increase the interior glass surface. The other arm of the pipette is connected to a water seal or rubber bag (Fig. B-4-2 shows rubber-bag connection) which forms an air seal for the solution in the pipette. Each of the pipettes contains a different solution. That nearest the burette contains potassium hydroxide solution used for absorbing carbon dioxide; the second pipette contains an alkaline

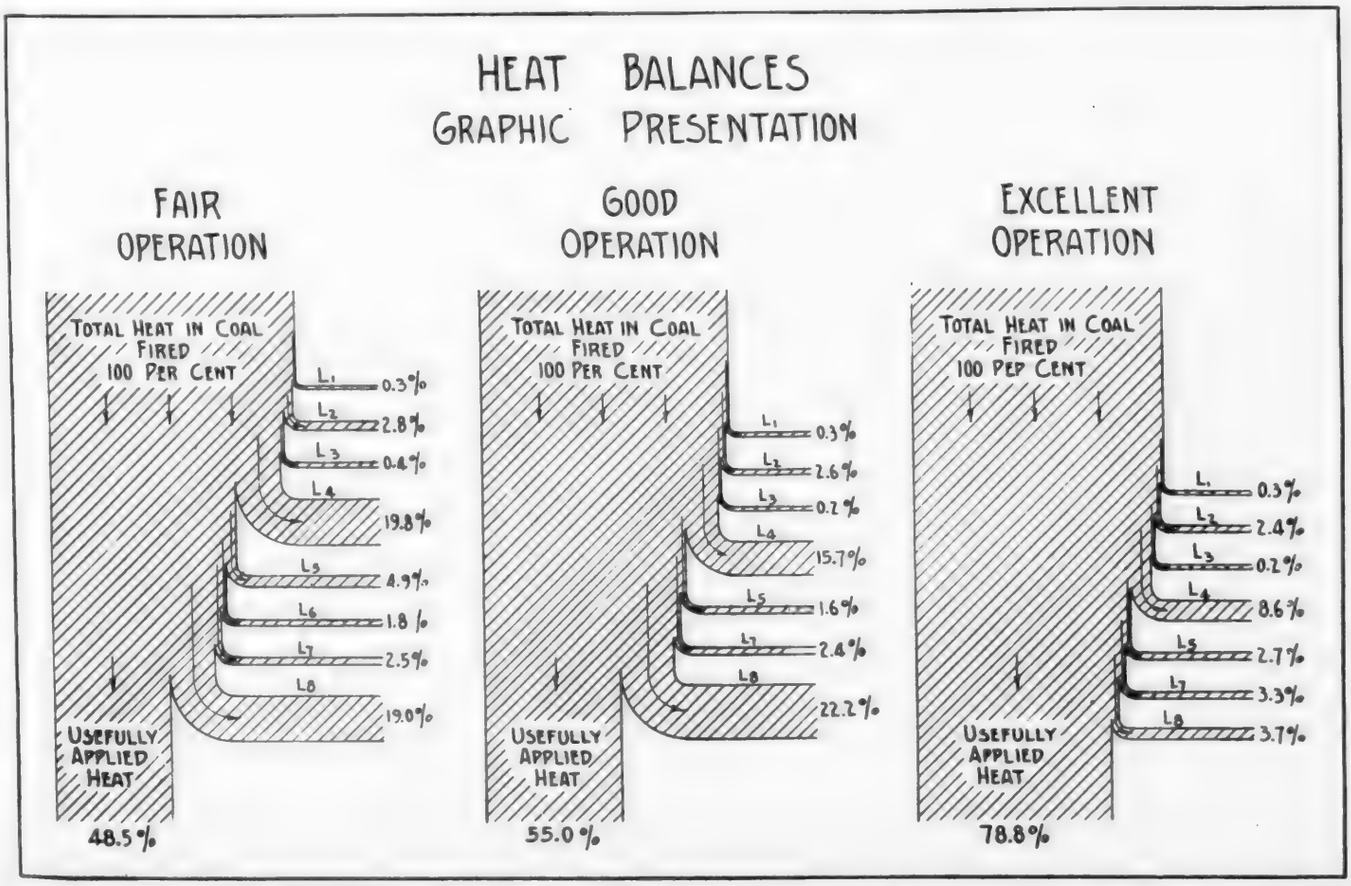

Fig. B-4-5. What Happens to the Heat Resulting from Coal Combustion in a Boiler Furnace Under Different Conditions of Operation

solution of pyrogallic acid used for absorbing oxygen, and the third pipette contains an ammoniacal solution of cuprous chloride used for absorbing carbon monoxide.

The Orsat apparatus is becoming more appreciated every day, not only for boiler test work, but for checking up on boiler operation either with coal or oil. The analysis of the flue gases tells the true story of the quality of combustion. It is not the province of this course to go into a discussion of combustion which is to be thoroughly covered in a subsequent course. The student, however, should appreciate (a) that efficient combustion is essential for efficient boiler operation (b) that combustion efficiency should not be confused with boiler efficiency and (c) that it is perfectly possible to have a boiler show high combustion efficiency and relatively low overall efficiency.

Referring again to Fig. B-4-1, the remaining three quantities, those by analysis and the heat value of the fuel must be obtained from laboratory analysis. Samples of the ash removed from the ash pit of coal burning plants are collected in a

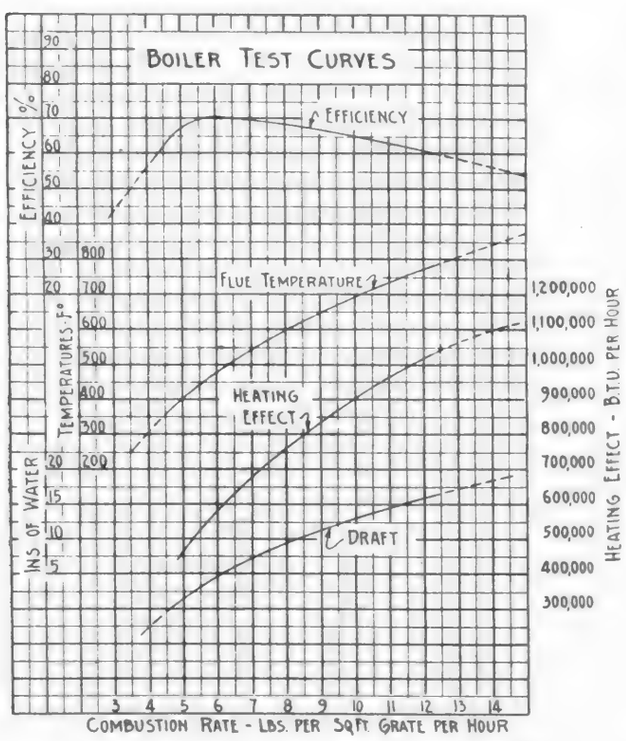

Fig. B-4-6. A Typical Set of Boiler-Test Curves

proper manner and sealed immediately. The heat value of the fuel is determined by means of an instrument known as a calorimeter.

On the basis of the ultimate analysis, heat value of the fuel used and test data gathered as given in Fig. B-4-1, there is illustrated graphically, in Fig. B-4-4, the heat available in the anthracite coal as fired and the distribution of this heat as determined by the test of the plant using it.

The total heat in the coal is plotted as 100% represented by the width of the chart at the top. The usefully applied heat delivered for warming the residence is shown as 59.2% and is represented by the width of the chart at the bottom. The quantities chargeable to the different losses are shown on the right of the chart. Each loss is designated by the letter L with a sub-number. They are enumerated in Table B-4-1.

The data shown in Table B-4-1 are the result of one test. As stated in the foregoing, boiler efficiency will differ with change in the combustion rate; distribution of losses changes and so it is necessary to treat each test separately.

Table B-4-2 shows three heat balances for the same boiler when operated with the same fuel but at different rates of combustion. A graphic presentation of these three heat balances is shown in Fig. B-4-5 where plant operation is noted as fair, good and excellent.

After a sufficient number of tests has been conducted, a boiler-efficiency curve, together with other characteristic curves, may be prepared.

Such a set of curves is shown as Fig. B-4-6. Combustion rate, in pounds of coal per square foot of grate per hour, has been taken as the basis of comparison. The boiler to which these curves apply was operated at rates from about 4.95 lbs. to 12.4 lbs. of coal per square foot of grate per hour.

The boiler-efficiency curve is typical of cast-iron, low-pressure heating boilers. Practically, they all have a "hump" indicating the point of highest efficiency which generally corresponds to a rate of fuel consumption between 5 and 7 lbs. per square foot of grate per hour. For the curve shown, it is apparent that an efficiency of slightly over 70% was obtained at a 6-lb. rate. When the boiler was forced by increasing the rate to 12 lbs. the efficiency fell to 61%. Thus it is apparent that a boiler showing highest efficiency at a 6 lb. rate should, if possible, be fired during the greater part of its operating period at or near this rate.

The heating-effect curve is plotted as total heat in B.T.U. added to the water per hour. At the lower combustion rates, this curve has a steep appearance, while at the higher rates, it begins to flatten, indicating that, although the fuel rate is increased, heating effect does not follow in the same ratio.

The draft curve shows the rate at which draft increases as more fuel is burned.

It should be noted that the flue-gas temperature curve rises fairly rapidly so that for the higher rates of combustion, the high flue-temperatures largely are responsible for the lower efficiency.

A study of similar curves from several boilers materially will aid the student in forming a true appreciation of boiler operation.

NO PROBLEMS ARE ASSIGNED WITH THIS LESSON

The next, and last, lesson in the boiler section will discuss boiler connections, cleaning, general consideration of selection, attention, operation and effect of heat losses on fuel costs.

PIPECRAFT

IX—Receiver and Vacuum Pumps—Connections and Controls

FOR conditions where radiation in gravity steam systems comes dangerously close to, or below, the water-line, the practice of using an automatic receiver-return-pump often is found a first-class solution. A large number of these pumps operate on the simple principle of having a tank or "receiver" into which all the condensation flows until the water level in the receiver rises to a point where a float is lifted and the pump started by this movement of the float; when the pump has returned the water so as partially to empty the receiver, the float drops back to its original position and automatically stops the pump.

While the details in various makes of receiver-return-pumps may vary, the above is the general principle of operation, and, as all of the starting and stopping of the pump is done by the float which, in turn, is controlled by the water rising

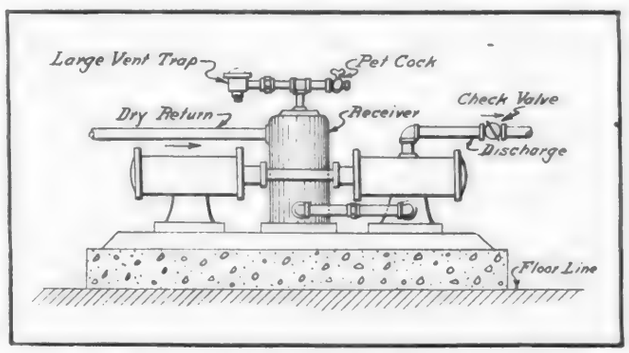

Fig. 71. Method of Making Dry Return Connections to an Automatic-Receiver-Return Pump

and lowering in the receiver, the pumps are termed "automatic."

To secure satisfactory operation in these pumps provision for the relief of air must be made, as the receiver, when installed, is full of air, and the return condensation will be hindered in entering the receiver unless this air is relieved. Some manufacturers install a pet cock and a check valve opening outward on the top of their receivers which works all right with a wet return, but with a dry return (where there is steam in the return line) the check will allow this steam to discharge into the atmosphere.

Consequently, where a dry return is connected to the receiver of a receiver-return-pump, a large-size automatic air valve should be substituted for the check valve and the connections to the receiver may be made as illustrated in Fig. 71.

With a wet return, either a check, as mentioned,

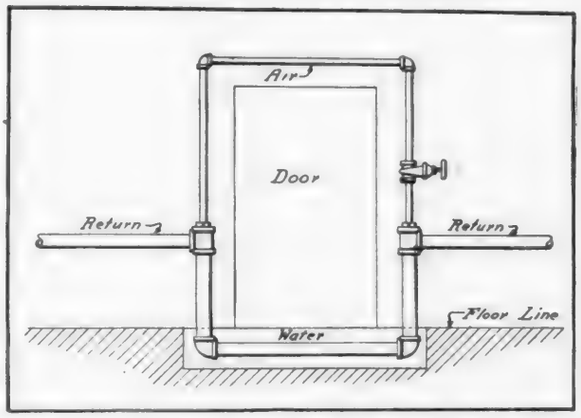

Fig. 72. Vacuum Return Main Run Under Floor With Air Line Overhead

will do or a small automatic air valve, such as is installed on a radiator, may be used.

Vacuum Pump Connections and Piping

Vacuum return mains—carrying both air and water—must be pitched constantly and uninterruptedly *down* from the farthest radiator to the connection to the vacuum-pump suction inlet; the only deviation from this rule is where a lift fitting is installed (as already has been discussed) and where a line necessarily may be run under the floor with an air line on the ceiling (see Fig. 72), or the same idea used to pass a deep beam or other obstruction, as shown in Fig. 73.

At the vacuum pump it is often desirable to condense the vapor in the vacuum return line by inserting a small amount of cold water or by using some type of cooler or condenser. The vapor in the vacuum return is caused by re-evaporation of the condensation under the higher vacuum exist-

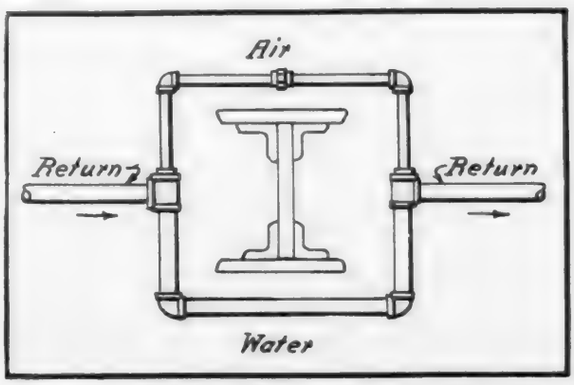

Fig. 73. Method of Passing Beam or Other Obstruction Without Using a Lift Fitting

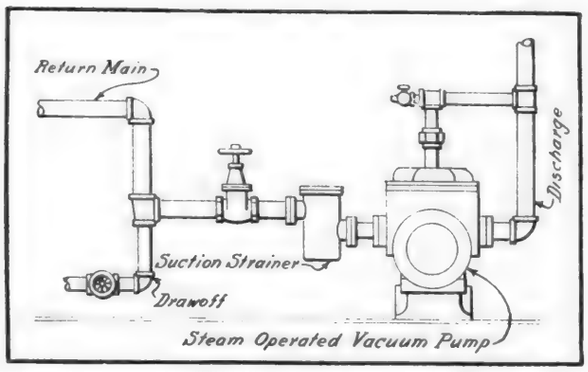

Fig. 74. Details of Return Connection to a Single Vacuum Pump

ing in the return line and, sometimes, by leakage of the traps on the radiators. Many vacuum systems operate without any cooling of the condensation and seem to give equal satisfaction, as far as operation goes; it is quite likely, however, that the vacuum on the return will not be as high as when the return is cooled artificially.

Besides putting dirt pockets on the bottoms of the risers, a strainer always is desirable on the return line just before it is connected to the vacuum pump suction inlet; this strainer is for the purpose of catching all dirt, scale and other foreign matter and keeping it out of the vacuum pump. To facilitate cleaning the strainer it is advisable to put a gate valve on either side so that by closing off both these gates at any time, the strainer may be cleaned of any obstruction retained therein.

It is also a far-sighted policy to install vacuum pumps in duplicate and also to provide a by-pass so that the condensation may be discharged to the sewer or other permissible point by gravity in case of emergency. The duplicate pump is desirable in case anything goes wrong with the regular pump and the emergency connection can be used if anything should incapacitate both pumps, such as the temporary failure of the steam supply on account of a damaged steam line for steam-operated pumps, or the breaking down of the electric current supply, in the case of electrically-driven pumps.

Where only a single pump is used, the vacuum return connections may be made as detailed in Fig. 74, and, if duplicate pumps are used, the connections may be modified as shown in Fig. 75.

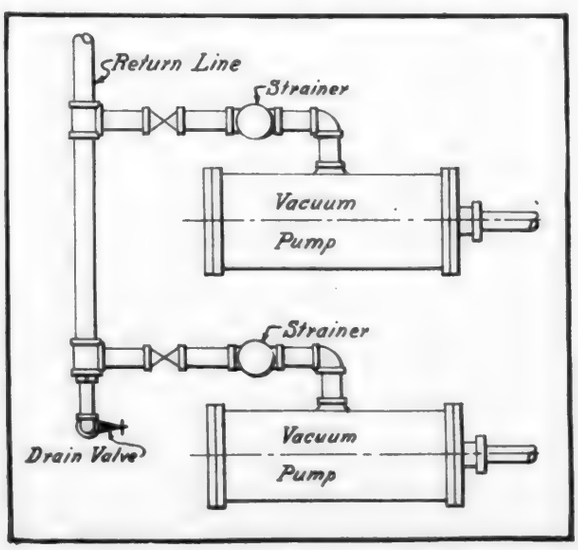

Fig. 75. Arrangement of Connections for Duplicate Vacuum Pumps

Vacuum Pump Control

The control used on vacuum pumps may be either hand or automatic, although the automatic is much better. With automatic control the pump may be set to maintain any predetermined vacuum within its limitations and, after being so set, automatically will maintain this amount of vacuum as long as operating power is supplied and the amount of condensation does not exceed its capacity. With steam-driven pumps the controller is arranged to admit high-pressure steam to the steam cylinder in such quantity as to move the pump piston with just enough speed to maintain the vacuum for which the controller is set; with electrically-operated pumps the controller starts and stops the pump at intervals so as to accomplish practically the same result.

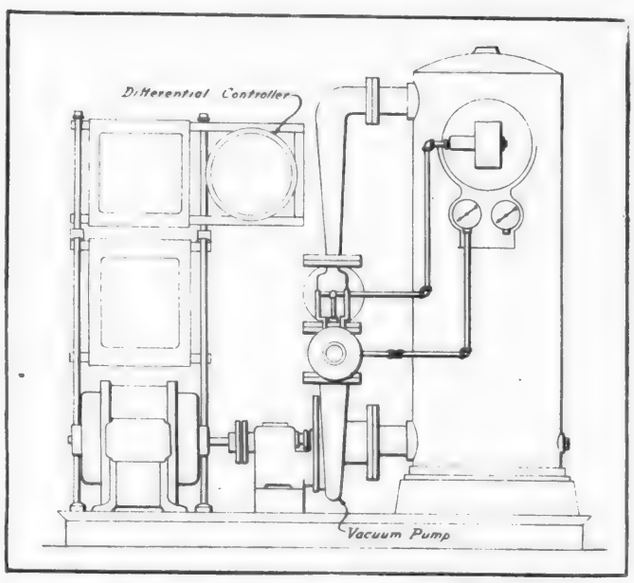

Fig. 76. Special Treatment of Return Line for a Constant Differential System

Fixed-Differential Vacuum Pumps

Recently, a departure in vacuum heating has been placed on the market, this type of vacuum system keeping a fixed difference in pressure between the pressure in the steam line and the pressure in the return line; this difference usually runs from 4 to 6 in. and the controller is of a different type. The principle on which the controller functions may be likened to that of the ordinary boiler-draft regulator, having a similar diaphragm and automatically controlling the pump so that any predetermined amount of vacuum or pressure *difference* constantly is carried at all times.

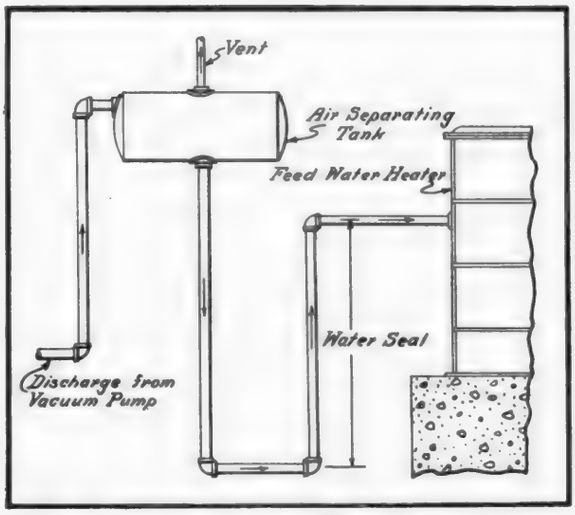

Fig. 77. Loop Seal Required When Air Separating Tank is Connected to Feed Water Heater Against the Heater Pressure

The return to the vacuum pump is carried through an "accumulator" before reaching the pump intake, and the discharge empties into an air-separating tank with a water level high enough to keep the pump primed. Typical connections for such an installation are given in Fig. 76, but the contractor will find that vacuum pumps of several differing types are now on the market and that the manufacturers' instructions for installation should be followed in each individual case. A fixed-differential system should not be expected to handle any lifts in the return, but otherwise any ordinary vacuum-piping installation of good design can be arranged to operate on a *fixed* differential as well as on the ordinary *variable* differential principle.

Air-Separating Tanks

The discharge from the ordinary vacuum pump contains both air and water, but it is not desirable to pump air back into the boiler or even into a feed-water heater when the returns are so handled. To allow the air to separate from the water, an air-separating tank is necessary into which the mixture of air and water is pumped, and from which the air passes off through a vent pipe, and the water leaves the bottom through a line running to an open feed-water heater or to a suction tank to supply the boiler-feed pumps. In cases where an open feed-water heater is used and a slight pressure is maintained on the feed-water heater, it is necessary to install a balancing loop-seal between the air-separating tank and the heater to overcome this difference.

A typical connection of this character is shown in Fig. 77 and it will readily be understood how a slight additional pressure in the heater would force its way back and out through the air-separating tank vent were it not for this seal. The height of the seal must be about 2 in. for every ounce of pressure carried in the feed-water heater in order to provide sufficient head to prevent loss of steam in this manner.

Next month: Vento heaters—connections for gravity steam systems, large sizes of heaters, automatic control, gravity-return connections, heater and return connections on vacuum systems, and equivalent direct radiation. Fin, and other heating surfaces of high efficiency also will be discussed.

T. E. B.'s Model Heating and Plumbing Store

At the convention of the National Association of Master Plumbers in Minneapolis in June, the T.E.B. model heating and plumbing store was exhibited, as described in THE HEATING AND VENTILATING MAGAZINE for August (page 97).

Fig. 1. Display Windows of T.E.B. Model Heating and Plumbing Store

Fig. 1 illustrates the display windows of actual size which window dressers demonstrated could be prepared at low cost. Layout of the model store and arrangement of the equipment are shown in Fig. 2. The exhibit was 75 ft. long and 25 ft. wide, and was the most complete of its kind ever shown.

This store embodied the results of seven years' experience in store planning and window display.

A booklet has been published describing the model store, and a copy can be had by writing to the Trade Extension Bureau, at Evansville, Ind.

Fig. 2. Arrangement of the Equipment in the T.E.B. Model Store

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THOSE close to the trend of events in the heating industry can say "I told you so" concerning the recent merger of six of the prominent boiler and radiator concerns. With the remarkable progress in the development of new heating methods and appliances, resulting in the success of many firms comparatively new to the industry, it was inevitable that there should be a regrouping of manufacturers in the same general field. By the same token it is easy to predict that similar mergers may be expected in other lines where the interests are close to each other or where they overlap.

In a larger way, however, the trend is even more significant in denoting the "arrival" of heating and ventilation as one of the major industries of the country. For years the rank and file have had a feeling that they were engaged in a minor occupation. This was natural, because it does not take a long memory to recall the time when it was literally true. Incidentally, it might be added that the feeling still prevails with the lay public. However, we dare say a few more mergers of the magnitude of the latest combination will awaken the public to a better appreciation of the extent of the heating field.

One indication that the public has only a hazy idea of the industry's scope is the frequent classification of "heating" as "plumbing and heating." Only recently a national organization of business papers made the same blunder, although it is only fair to say that the officials were quick to see the error and to make the proper correction when the matter was called to their attention. As a matter of fact, the broadening of the heating field, brought about by the evolution of self-contained heating and ventilating units, has had the effect of inducing many plumbers to branch out as heating contractors.

IT IS a curious fact that while the trend in the organization of the industry has been towards larger units, the trend in the application of the art has been in the opposite direction—towards the smaller, self-contained units. To-day we have self-contained unit ventilators, unit fan heaters, unit air-conditioning outfits and unit air filters, and the end is not yet. In a sense this has tended to make the marketing of heating appliances more or less of a merchandising proposition and this easily may account for the increased interest in the field taken by plumbers and others. But, at best, the merchandising of heating units can apply only to the smaller classes of installations, and the field will continue, as in the past, to require the same high grade of engineering talent that has brought it to its present place.

While this is being written the American Gas Association is planning its most ambitious exposition in Chicago, with the emphasis placed on the use of gas for house-heating. At the same time the oil-burner industry is bending every energy to consolidate its position which, during the past two years, has become one of great strength. With these two interests struggling for mastery, and with the field already enlarged through the development of unit apparatus, the position of heating and ventilating among the major industries is fixed. It is for us to shake off our "minor industry" complex and to push out that "third button" as we proceed to measure up to our opportunities.

WHEN we were told, not long ago, by a competent weather expert, that the American climate was growing colder and would remain so, at least for the next century, the temptation was to pass it on as another vagary of an enthusiast gone wrong. It now appears, however, that this prediction was based upon observed changes in the temperature of the ocean currents, induced, in turn, by the increasing number of sun spots and the consequent lessened solar radiation. As is well known, there is a considerable variation in the temperatures of different ocean currents and if it is true, as he says, that in both the Pacific and Atlantic oceans the warm water currents are growing colder, it is easy to conceive how vast an effect this would have on our climate.

Will These Changes Improve the Boiler-Rating Code?

Suggestions Made By James Neil Cover Points of Major and Minor Importance and Endorse Desirability of Code

IN response to an appeal in THE HEATING AND VENTILATING MAGAZINE for August, for constructive criticism of the low-pressure boiler-testing code proposed in the American Society of Heating and Ventilating Engineers, James Neil, chief engineer of the International Heater Co., Utica, N. Y., has offered the suggestions that follow. These immediately were forwarded to the members of the committee responsible for the formulation of the proposed code, but too late to receive their replies for publication in this issue.

It is hoped that this opening will stimulate others, who are qualified to discuss this important question, in making known their suggestions for improvement or their endorsement of the code as it now stands.

Mr. Neil writes:

"These recommendations are submitted with a view to, and in the hope of, the ultimate adoption of a boiler-testing code which shall be acceptable to all manufacturers, heating engineers, architects and contractors. It does not seem to me that this is an unattainable ideal, provided all those interested contribute of their best and unprejudiced thought in the matter.

COMBINING A.S.H. & V.E. AND H. & P.C.N.A. CODES

"In the January, 1924, issue of the A.S.H. & V.E. Journal there was printed a code for testing low-pressure heating boilers which indeed was very thorough. Another slant on the same problem was the code of the Boiler Output Committee of the Heating and Piping Contractors National Association, which included a chimney chart, method of firing, the number of tests at various ratings above and below the point of highest efficiency, the results of which were plotted on a boiler-performance chart. The combination of the two made the best code for testing boilers that had ever been offered to the industry. There was not a single legitimate question pertaining to the operation of the boiler that was not answered by an examination of the performance chart. It enabled the architect and heating engineer to select a boiler best suited to meet any condition.

"The proposed A.S.H. & V.E. code has many good features, indicating that a lot of time and thought has been given to it in the interest of simplicity, but I think it has gone too far in that direction. Suppose a test has been made in accordance with this code; what do we know after it is completed? We know the weight of fuel that was placed on the grate, the draft, flue-gas temperature, flue-gas analysis, pounds of steam generated, and the quality of the steam. This, of course, is very useful information, but it is not enough. We should know the thermal efficiency of the boiler and the weight of fuel burned per square foot of grate per hour, if it is to be complete.

"If the A.S.H. & V.E. 1924 code, the code of the Output Committee of the H. & P.C.N.A., and the many good specifications that are in this latest proposed code were combined, these organizations, the boiler manufacturers, and the entire industry would have a test code that would favorably compare with anything of its kind now in existence. Why not broaden out the committee by including a representative from each of the allied interests in the heating business?

"Referring, now, to the code, as printed in THE HEATING AND VENTILATING MAGAZINE for August, I would suggest the following:

"Under the heading,

Rating Definition

"Paragraph 1: The separator used shall be not less than 95% efficient. It is necessary that some limitation be stated; otherwise, any device might be used that, in the opinion of those making the test, would act as a separator.

"Paragraph 2: Flue-gas temperature of 700° F. is satisfactory, but, in view of the fact that a low-pressure heating boiler operates the greater part of the time on a load considerably less than what it has been installed to carry, the flue-gas temperature could be raised to 850° F. without creating a very serious flue-gas loss, averaging it through the heating season.

"To arrive at the average flue-gas temperature, some specified time between the readings should be stated; otherwise they may be taken too far apart, and at times when the condition of the fire would make the temperatures, as read, an incorrect index of conditions.

"I would suggest that this paragraph read:

"'During the test the average temperature of the flue gases leaving the boiler shall not exceed 850° F. The temperature readings shall be taken every 10 min.'

Standard Ratings

"Bituminous coal: Change the volatile matter content to read:

"'30% to 40%.'

"This will permit of a slightly greater flexibility in the selection and a possible saving in the cost of the fuel in some cases, because of the difference in freight differential.

Test Specifications

"Test Method A: Substitute for the last sentence:

"'The water level in the boiler shall be the same at the start and finish of the test.'

"This is an essential requirement. It is possible, under running conditions, to feed as much as 1000 lbs. of water into a boiler of, say, a rating of 20,000 ft., without raising the water level perceptibly. Such being the case, and in the absence of definite instructions in the code, it might be possible for the persons conducting a test to allow the water to drop to a lower level than at the start, just prior to the expiration of the test. Obviously, this would result in an improper deduction that might affect the rating by as much as 20% or 25% of the capacity of the boiler.

Measurements and Instruments

"Flue-gas temperature: Change the first sentence to read:

"'Thermocouples shall be used to measure the flue-gas temperature.'

"Change second paragraph of notes to read:

"'Unprotected copper - constantin couples of 0.025 in. diameter shall be used.'

"With an unprotected thermocouple the response to changes in temperature is rapid; there is practically no lag. Therefore, greater accuracy is possible.

"Change the last paragraph of notes to read:

"'The instruments used with the couple should be sensitive to at least 5° F., and a range up to 1200° F. should be sufficient.'

"In my opinion, the instrument should be capable of indicating fluctuating high

temperatures which may exceed the specified range of 1000° F.

"CO_2 percentages: Change next to the last paragraph to read:

" 'An Orsat gas analyzer shall be used.'

Official Test

"Paragraph 10: Substitute for this paragraph the following:

" 'The boiler shall be in operation, under test conditions, for a period of not less than 1 hr. before starting the test. The thickness of the fuel bed shall be measured and the extent to which it has been burned through shall be estimated. At the end of the test the fire shall have the same amount of live fuel on the grate as at the start and shall be burned through to the same extent as at the start. When this condition has been reached and the water level in the boiler is at the same height as at the start, the test shall then be closed.'

"Firing and attendance: Omit paragraph 1 and substitute:

" 'The firing period for burning anthracite coal with 20% reserve shall be as follows: For boilers with 8 sq. ft. of grate or less, 8-hr. period; for boilers with 8 to 12 sq. ft. of grate, 6-hr. period; for boilers with 12 to 18 sq. ft., 4-hr. period; for boilers with over 18 sq. ft. of grate, 2-hr. period.'

"Change paragraph 3 to read:

" 'nor less than 5 lbs. for bituminous coal.'

"While 10 lbs. of bituminous coal per square foot of grate may be all right for the small boiler, it obviously is disproportionate for the large-sized boiler with, say 30 sq. ft. of grate, and under constant attention. With a grate of this size, it would mean a minimum charge of 300 lbs. of coal; in my opinion this would be poor practice, since it would require a high draft-tension to develop an amount of work consistent with the size of the boiler.

"Omit paragraph 4.

"Duration of Tests: Eliminate paragraphs 1 and 2 and substitute:

"Paragraph 13—'Duration of Tests.'

" 'With test-methods A or B, the official test periods shall be as follows:

" '1. With anthracite coal

Boilers with 8 sq. ft. of grate or less, 16 hrs.

Boilers with grates 8 to 12 sq. ft., 12 hrs.

Boilers with grates 12 to 18 sq. ft., 12 hrs.

Boilers with grates over 18 sq. ft., 12 hrs.

" '2. With bituminous coal

All sized boilers—12 hrs.' "

How Should Smokehood Temperatures Be Handled in the Code?

AN engineer of prominence in the industry has submitted the following letter embodying his views of the code. The letter was submitted to Chairman Kellogg of the Code Committee, and his reply also is published here:

EDITOR THE HEATING AND VENTILATING MAGAZINE:

There are many things in the proposed boiler test-code that are good, but the governing features of it are extremely bad. It shows, on the face of it, that there has been too much theory put into it with too little knowledge of the practical working of boilers in homes. For instance, it limits the priming of a steam boiler to 2% moisture in the steam. This is good, but then it limits the flue gases to 700° F. That might be all right if the boiler always is operated at a constant load; however, that is not a fact. The morning peak load, especially on a sub-zero morning, will produce a much higher flue temperature than 700° F., but for a short period of time, and the boiler which would operate under these conditions of high flue-temperature, on such a morning, probably would be a much more efficient boiler for the total heating season than one the Heating Code Committee would have us use that would never exceed 700° F. stack temperature.

Then again, when I buy an automobile, or an electric motor, or an aeroplane, or a house heating boiler that is rated by some rating code, I should know the ultimate capacity of such apparatus. "The capacity of a house heating steam boiler is that amount in pounds weight of steam which the boiler will deliver at its nozzle without priming." This has nothing to do with stack temperature, size of grate, amount of direct or indirect heating surface. The code would fix the priming at 2% moisture. That is quite all right and is a quantity which can readily be determined so that the capacity of the boiler equally can be determined. The capacity of a 5-gal. water can is 5 gals. of water, not 4 gals. and not 5½ gals. It holds 5 gals. at the point of overflowing. So should the capacity of a boiler be determined at its point of overflowing, which, in terms of the code, is 2% moisture in the steam.

I think it would be clear to you that, if the code were adopted as it is, it would work a hardship on the purchaser of the boiler as well as place a premium on poor and inefficient boilers.

The reply from the chairman of the committee is as follows:

EDITOR THE HEATING AND VENTILATING MAGAZINE:

The committee on Rating Low-Pressure Boilers always is glad to receive comments and criticisms on its proposed code, but it wishes that correspondents would criticize in a constructive manner. It is very easy, indeed, to say that this or that should *not* be done, but when a feature is objected to *something better should be offered in its place.*

We notice that the writer of this letter does not object to the 2% moisture content in the steam, which we tentatively have agreed upon, but he does object to placing a limit of 700° F. on flue-gas temperature. In this connection it might be said that the committee has offered a figure tentatively and may or may not finally settle upon 700° F. as being the best temperature to adopt.

I interpret the letter from your correspondent as suggesting that the smokehood temperature limitation be eliminated from the code, and that priming be the only limitation to rated output.

Does the writer believe that this would satisfy the statement of "Purpose" as given by the code? Would it not at least be necessary that the smokehood temperature obtaining in the test should be included in the rating value so that one manufacturer would give his rating as "1000 sq. ft.—700° F.", and another, for a boiler having larger steam space and less heating surface, as "1000 sq. ft. —1400° F.?" Surely the purchaser should have the ability to know the smokehood temperature even if it is not limited by the rating code.

Your correspondent also misses the point entirely in that he fails to appreciate what the committee has in mind as the proper definition of the word "rating." What we believe a code should do is to provide a definite method of testing boilers that will be adopted by all manufacturers solely for the purpose of comparing boiler performance. There would be no restriction whatever to increasing somewhat the flue-gas temperature, provided the rating was established in accordance with the temperature laid down by the code. In house-heating boilers we believe it would be very poor practice to attempt to operate at an average temperature in excess of 700° F., especially if the boilers are to be operated over any particular period with one firing. Again, it seems as though it would be rather difficult to maintain the agreed-upon moisture content of 2% with any material increase in flue-gas temperature. This might vary with different types of boilers, but not materially so.

The writer of this letter suggests that, in purchasing an electric motor or other device, he would wish to know "the ultimate capacity of such apparatus." We believe, however, that he will find that codes for testing such devices are prepared strictly for the purpose of comparison and do not really limit the ultimate performance of the apparatus to the figures set in codes prepared for comparative purposes.

The committee hopes to receive further correspondence from interested parties, asking them to keep in mind that what the committee most needs are definite suggestions of what to do in the event of correspondents disagreeing with the tentative conclusions the committee has already reached.

(Signed) Alfred Kellogg,
Chairman, A.S.H. & V.E. Committee on Rating Low-Pressure Heating Boilers.

Value of Roof Insulation Proved in Heating Eastman Theater

THE value of roof insulation, not only in fuel economy but in more satisfactory heating of a large theater and school of music, is evidenced by a report recently made by A. C. Nielsen Company, in collaboration with and approved by G. A. Livingston, superintendent of the Eastman Theater and School of Music Building, from which the following extract is taken:

BUILDING LAYOUT

The Eastman Theater and School of Music Building, Rochester, N. Y., consists of a one-story auditorium and a six-story front portion hereafter referred to as the theater and office section and of a four-story-and-attic portion in the rear which houses the Eastman School of Music.

The construction is of steel frame throughout with stone front and brick and hollow tile side walls and partitions. The theater and office section has a total volume of 3,281,435 cu. ft. and the school section of 1,886,436 cu. ft.

ROOF INSULATION PROBLEM

The need of insulation on the roof of the auditorium and of the office section became apparent soon after the building was completed in 1922. The direct-radiation steam heating system in the office section appeared to be functioning perfectly except that it was found extremely difficult to get a satisfactory distribution of heat to the upper floors. Heat was supplied to the auditorium through an air-conditioning system capable of effecting a complete change of air every 8 minutes. This was satisfactory as far as the heating of the auditorium was concerned, but it was evident that proper distribution in the entire theater and office section could best be assured by insulating the roof of the auditorium as well as that of the six-story office section where the major difficulty had been experienced.

The Eastman Research Laboratories undertook the problem of selecting a suitable roof insulating material. A series of tests was made of the heat insulating quality and physical properties of several materials, and Armstrong's corkboard was selected for the purpose.

APPLICATION OF INSULATION

The total roof area of the theater and office section is 17,000 sq. ft. The original roof was a 5-in. concrete slab carried on steel roof trusses at a pitch of approximately 35° and covered with asbestos roofing.

The insulation, 2 in. thick, was applied on the outside of the original roof, cemented on, and covered with another layer of asbestos roofing, during the summer of 1925.

The useful life of the roof with insulation may be assumed as 20 years—the asbestos roofing being guaranteed for a minimum of 10 years. The total cost of insulation and new roofing was $4,876 and the annual cost, considering depreciation, average interest and a maintenance allowance of 0.5%, is $421.77.

EFFECTIVENESS OF INSULATION

The insulation fully demonstrated its economy during the first heating season. A comparison of fuel consumption for seasons immediately before and after the change showed a very substantial saving; the reduction of heat loss was clearly indicated, even before this comparison was made, by the fact that snow accumulated on the insulated roof in considerable quantities whereas it had formerly melted almost at once.

SAVINGS EFFECTED

Tables 1 and 2 present data showing the economic value of corkboard insulation. The fuel consumption of the boiler plant supplying steam for the heating systems in both theater-office and school sections was 3043 tons in the 1924-5 season before the insulation was applied and 2700 tons in the 1925-6—the first heating season following the change. The actual saving was, therefore, 343 tons, not considering the difference in weather conditions of the two seasons.

A correction for weather conditions is made on the basis of data shown in Table 2. A study was made of the U. S. Weather Bureau records for the two heating seasons, considering daily mean temperatures for nine-month periods extending from September 1 to May 30.

From Table 2 it appears that there were 6595 degree-days in the 1924-5 season and 7280 degree-days in the 1925-6 season. It is apparent from this that the latter season actually required a considerably greater amount of heat than the former and, with all other conditions remaining the same, the fuel consumption in the 1925-6 season actually should have been 110.4% of that in the season preceding.

Without roof insulation, therefore, the fuel consumption for the 1925-6 season would have been (1.104 x 3043 tons) 3359 tons. The fuel saving creditable to the use of roof insulation is theoretically 659 tons and the actual credit, with fuel at $5.25 per ton, is $3,459.75.

Table 1 shows this saving, calculated on the basis outlined above, and indicates what deduction should be made to take account of the added fixed charge on the investment in insulation. This fixed charge is $421.77 per year and the net saving effected by the use of insulation in the 1925-6 season is therefore $3,037.98.

The saving in the first season thus repaid about 62% of the total cost of putting the insulation in place. A change to central-plant steam supply during the 1926-7 season prevents the extension of calculations to that period because records are not sufficiently complete. It seems reasonable to believe, however, that the use of insulation will show comparable heating-cost savings in later seasons and it is therefore evident that the total initial investment will be repaid many times over during the expected life of 20 years.

TABLE 1

Annual Saving Effected By Use of Roof Insulation

Gross Saving in Fuel	
Cost uninsulated, 1924-5 3359 tons (Table 2) x $5.25	$17,634.75
Cost as insulated, 1925-6 2700 tons (Table 2) x $5.25	14,175.00
Gross savings in 1925-6 season	$3,459.75
Cost reduction	19.6%
Less Fixed Charges on Roof Insulation	
Depreciation—$4,876.00 ÷ 20-year life	$ 243.80
Average interest @ 6%— 21/20 x $4,876.00 x .06/2	153.59
Maintenance allowance (0.5%)	24.38
Total annual fixed charge	$ 421.77
Net Saving Effected Over 1924-5 Season	
Gross saving less added fixed charges	$3,037.98
Return on investment in insulation	62%

TABLE 2

Heating Load Correction Data

	Degree-Days	
Months	**1924-5**	**1925-6**
September	201	131
October	411	660
November	740	753
December	1215	1137
January	1317	1192
February	922	1163
March	847	1144
April	541	760
May	401	340
Totals	6595	7280
Percent 1924-5	100.0	110.4
Fuel Requirements:		
Actual (tons)	3043	2700
Corrected, with 1924-5 season as basis (tons)	3043	3359

Insulating Materials and Their Various Properties

A Report to the American Gas Association by the Sub-Committee of Its House Heating Committee*

WITH the resistance of an inch thickness of each material and also for the commercial thickness or thicknesses of the various materials, it is a very simple matter, by the addition of the reciprocals of the various factors of the proposed wall, to calculate the over-all heat loss constant of any proposed wall.

EXAMPLE

Assume a frame wall clapboard, sheathing, studding, lathed and plastered, the B.T.U. transmission of which is 0.28. Now let us insulate this wall with 1½ in. of corkboard. From our table we find the resistivity of the 1½-in. cork to be 4.96. By the addition of resistivities we have the following:

$$K = \frac{1}{\frac{1}{0.28} + 4.96} = \frac{1}{3.57 + 4.96} = \frac{1}{8.53} = 0.12.$$

By the application of this constant to any B.T.U. loss formula used in the calculation of heat losses we have the insulating value per heat saving value of 1½ in. of this insulation material.

Let us apply it to a second example; a 4-in. brick wall, furred, lathed and plastered. The heat loss of this uninsulated wall is 0.33. By the addition of the resistivities of the various materials in this wall, we have:

$$K = \frac{1}{\frac{1}{0.33} + 4.96} = \frac{1}{7.99} = 0.13$$

With the above examples, let us apply this to an entire house. Assume a home with 1450 sq. ft. of exposed wall figured from 70° to —10°, we have the following:

IT has been the desire of the American Gas Association, for some time past, to get absolute facts regarding the heat insulation properties of the various insulating materials on the market to-day that are recommended for insulating homes.

With this view in mind, the chairman of the House Heating Committee of the association this year appointed a sub-committee to ascertain and tabulate these facts on as many of the recommended insulations on which they could get authoritative data. The committee has endeavored to place before the association only those facts pertinent to the proper insulation of homes.

The table accompanying this report gives the findings of the committee, placing in a condensed form the important factors to be considered in house insulation.

The following factors were considered in the report:

1. Name of the material.
2. The commercial form of the material.
3. The commercial thickness or thicknesses in which the material was manufactured.
4. Density, pounds per square foot per inch thickness.
5. Commercial conductivity stated in B.T.U. per square foot per inch thickness per degree F. temperature differential per hour. (Hot plate.)
6. The resistivity per inch thickness.
$$\frac{1}{\text{commercial conductivity}}$$
7. Resistance for commercial thickness or thicknesses.
8. The authority for the conductivity factors quoted.
9. Cost per thousand square feet of commercial thickness or thicknesses.

WALLS

Uninsulated:

1450 × 0.28 × 80 = 32,480 B.T.U. loss through uninsulated walls.

Insulated with 1½ in. of the above insulation:

1450 × 0.12 × 80 = 13,920 B.T.U. loss through insulated walls.

CEILINGS

Uninsulated and lathed and plastered, no floor above.....0.48
Insulated with 1½-in. cork.....0.14
Uninsulated, lathed and plastered, single floor above.....0.28
Insulated with 1½-in. cork.....0.12

Assuming that we have 900 sq. ft. of exposed ceiling heated from —10° to 70°, we have:

Uninsulated:

900 × 0.48 × 80 = 34,560 B.T.U. loss.

Insulated:

900 × 0.14 × 80 = 10,080 B.T.U. loss.

The above factors, namely, the heat loss through the walls and through the ceilings, are the two sources of heat losses which insulation affects, heat absorbed by air changes and losses through windows and doors remaining approximately the same. The above examples, however, do illustrate quite clearly the fuel saving that can be effected by the proper application of insulation in constructing a home.

Assuming this hypothetical home to have 1450 sq. ft. of exposed frame wall, an exposed ceiling of 900 sq. ft., which is lathed and plastered, with no floor above, 175 sq. ft. of exposed glass and 100 sq. ft. of door, the computations following the form shown on the opposite page indicate the decreased heat loss where insulation is used.

Movement to Standardize Welding Apparatus

Standards for electric arc and resistance welding apparatus have been submitted to the American Engineering Standards Committee as a basis for national standards on these subjects by the American Institute of Electrical Engineers.

The standards submitted as a base of national uniformity include nomenclature, methods of making dielectric tests, and methods of rating, to be used as a basis of guarantee for the following types of apparatus used in electric and resistance welding operations: direct current generators, motor generator sets, transformers, resistors, and apparatus for electro-percussion welding. Butt, flash, pressure-contact, spot, and seam welding are differentiated.

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* *As presented at the A.G.A. Convention, Chicago, Oct. 10-14, 1927*

The following authorities have been quoted in the factors presented herein:

J. C. Peebles, Armour Institute of Technology, United States Bureau of Standards; Prof. F. B. Rowley, University of Minnesota; G. F. Gebhardt, Armour Institute of Technology; American Society of Heating and Ventilating Engineers; Prof. Gordon B. Wilkes, Massachusetts Institute of Technology; Prof. A. C. Willard, University of Illinois.

In the case of a question arising as to the proper factor to accept, a circular letter, No. 227, dated April 19, 1927, issued by the Bureau of Standards, was taken as the final authority since it was the latest report from that source.

Analysis of Insulating Materials Made by American Gas Association

Material	Commercial Form	Commercial Thickness Inches	D	K	R	Resistance for Commercial Thickness or Thicknesses	Authority for Conductivity	Cost per 1000 Sq. Ft. Commercial Thickness or Thicknesses
						Inches		*Inches*
Balsam wool	Flexible blanket flanges between studs and rafters	½	0.246	0.229	4.37	½ — 2.18	Peebles	½ $45.00–$50.00
Balsam wool	Rolls 250 sq. ft. each	1				1 — 4.37		1 75.00– 80.00
Cabot's quilt	Flexible roll nailed on studding and rafters	¼	0.3	0.25	4.00	¼ — 1.33	U.S. Bureau of Standards	¼ 23.00
		½				½ — 2.00		½ 32.00
Cabot's quilt	Rolls of 250 sq. ft. 4 ft. wide x 7 ft., 8 ft., etc., long	⅝				⅝ — 2.66		⅝ 42.00
		⅝				⅝ — 2.66		⅝ 42.00
Celotex	Standard building board	7/16	1.13	0.33	3.03	7/16 — 1.325	Gebhardt	7/16 55.00
Celotex	Industrial board	½				½ — 1.55		50.00
Corkboard	Boards 12-in. x 32-in. x T	1	0.82	0.302	3.31	1 — 3.31	U.S. Bureau of Standards	1 97.50
Corkboard	Cemented to brick	1½				1½ — 4.96		1½ 93.33–1-in. thick
Corkboard	Nailed to frame	2				2 — 6.92		2 in. and over 90.00 per 1-in. thickness
Corkboard		3				3 — 9.93		
Fibrofelt	Flax and rye fibre, semi-flexible	½	1.09	0.32	3.13	½ — 1.56	U.S. Bureau of Standards	
Fibrofelt		5/16	1.09	0.32	3.13	5/16 — 0.975		$38.00
Fibrofelt		½				½ — 1.57		50.00
Fibrofelt		¾				¾ — 3.13		76.00
Flaxlinum	Flax fibre semi-rigid flanged between studding and rafters	½	1.08	0.31	3.23	½ — 1.62	U.S. Bureau of Standards	60.00
		1				1 — 3.23		95.00
House line	Felted cattle hair sewed between paper and felt	¼	1.08	0.27	3.7	¼ — 0.92	U.S. Bureau	40.00
Insulex 12	Powder mixed on job and poured	1	1.0	0.40	2.5	1 — 2.5	U.S. Bureau	1 30.00
Insulex 12	Forms cellular material between studs	2				2 — 5.0	U.S. Bureau	2 60.00
		3				3 — 7.5	U.S. Bureau	3 90.00
Insulex 12		3⅝				3⅝ — 9.1	U.S. Bureau	3⅝ 108.00
Insulex 12		4				4 —10.0	U.S. Bureau	4 120.00
Insulite	Felted wood fibre board	½	1.35	0.34	2.94	½ — 1.47	U.S. Bureau	½ 56.00
		1				1 — 2.94	U.S. Bureau	1 108.00
Linofelt	Flax fibres between paper	½	0.41	0.299	3.36	½ — 1.68	U.S. Bureau	
Linofelt	Flax fibres between paper	5/16	0.41	0.299	3.36	5/16 — 0.893	U.S. Bureau	24.00
Linofelt		½				½ — 1.68	U.S. Bureau	32.00
Lith	Flexible board containing rock, wool, flax and straw pulp	1	1.2	0.40	2.5	1 — 2.5	U.S. Bureau	95.00
Masonite	Exploded wood fibre	7/16	1.22	0.328	3.05	7/16 — 1.34	Armour	55.00
Thermocrete	Powdered gypsum mixed on job and poured. Forms cellular material between studs	1	1.0	0.40	2.5	1 — 5.2	Peebles	1 16.33
		3⅝			5.0	3⅝ — 9.1		3⅝ 59.92
		4				4 —10.0		4 66.12
Mineral wool	Filling material for walls *Various*		1.17	0.28	3.57	3½ —13.04	Armour	3½ 39.00
Thermofill	Filling material for walls		2.17	0.52	1.92	3⅝ — 6.96	Armour	117.75

D—Density, pounds per square foot, 1 in. thickness.
K—Commercial conductivity, B.T.U. per square foot per 1-in. thickness per degree F. temperature per hour.
R—Resistivity per inch 1/K.

Computations for Solution of Hypothetical Insulation Problem

(See third column on opposite page)

UNINSULATED

Walls	1,450 × 0.28 × (70° to — 10°)	= 32,480 B.T.U.
Ceiling	900 × 0.48 × (70° to — 10°)	= 34,560 B.T.U.
Windows	175 × 1.1 × (70° to — 10°)	= 15,400 B.T.U.
Doors	100 × 0.56 × (70° to — 10°)	= 4,480 B.T.U.
Air Change	13,700 × .018 × (70° to — 10°)	= 19,728 B.T.U.
	Total heat loss	= 106,648 B.T.U.

INSULATED

Walls	1,450 × 0.12 × (70° to — 10°)	= 13,920 B.T.U.
Ceilings	900 × 0.14 × (70° to — 10°)	= 10,080 B.T.U.
Windows	175 × 1.1 × (70° to — 10°)	= 15,400 B.T.U.
Doors	100 × 0.56 × (70° to — 10°)	= 4,480 B.T.U.
Air Change	13,700 × .018 × (70° to — 10°)	= 19,728 B.T.U.
	Total	= 63,608 B.T.U.
	Heat loss saving	= 43,040 B.T.U.

Chimney Performance Tables

TWO tables on chimney performance, which were developed in the course of an extensive investigation of the subject, by the Frost Research Laboratory, Norristown, Pa., Robinson V. Frost, C.E., director, are presented in the *Test Log*, published by the laboratory. The tables, it is stated, have been liberally proportioned and have been found to coincide with best practice. If restricted areas are allowable, the instructions given in note under Table I should be followed. The tables were first published by the American Society of Heating and Ventilating Engineers. They are now reproduced in a revised and improved form.

How to Use the Tables

TABLE I—CHIMNEY AREAS

This table requires that there be known two factors regarding boiler performance, namely,

(a) Pounds of coal burned per hour.
(b) Temperature in boiler smokehood.

Knowing these two factors, the volume of gas (in cubic feet per second) passing through the chimney can be read from the table.

Example. (a) = 100 lbs.
(b) = 600°

Resultant volume of gas is 18.10 cu. ft. per second.

Having found the volume of gas the gross area of the chimney can be determined by dividing the volume by the corresponding velocity.

Example. Volume = 18.10 cu. ft.
Velocity = 8 (approaching 10 ft.)

Resultant gross area of chimney is 2.00 + sq. ft.

Having determined gross area, the chimney dimensions can be read in the lower left-hand block.

Example. Gross area = 2.00 + sq. ft.
Dimension is 16 in. x 20 in.

TABLE II—CHIMNEY HEIGHTS

This table requires that there be known

(a) Whether the chimney shall develop maximum capacity at zero or 30° F. outside temperature.
(b) Temperature in boiler smokehood.
(c) Required draft on boiler, measured at boiler smokehood.

(a) Shall be chosen dependent upon latitude. In all northern states zero temperature should be selected, in southern states, 30° F. The 50°, 70° and 80° tables are to be used for reference and comparison.
(b) Is selected as for Table I.
(c) For required draft at foot of chimney add to required draft at boiler smokehood 0.02 in. draft multiplied by length of smoke pipe in feet, plus 0.05 in. for each elbow, provided there is no restriction in diameter of pipe.

The available draft should be at least 25% greater than required draft to provide a reasonable factor of safety.

Knowing outside temperature, temperature in smokehood, and available draft, the height of chimney can be read in

TABLE I—CHIMNEY AREAS

Pounds Coal Burned per hour	Gas Velocity Feet per second See Note	Volume of Gas (cubic feet per second) Passing through Chimney at Various Boiler Smokehood Temperatures						
		300°	400°	500°	600°	800°	1000°	
10	5	1.3	1.49	1.63	1.81	2.16		Volumes of Gas are calculated on basis of 24 pounds of air required for the combustion of one pound of coal.
20		2.6	2.98	3.26	3.62	4.32		
40		5.2	5.96	6.52	7.24	8.65		
60		7.8	8.95	9.78	10.85	12.95		
80	8	10.40	11.90	13.00	14.50	17.30		
100		13.00	14.90	16.30	18.10	21.60		
125		16.25	18.60	20.35	22.60	27.00		
150		19.50	22.35	24.45	27.10	32.40		
175	10	22.75	26.10	28.55	31.70	37.80	43.40	
200		26.00	29.80	32.60	36.20	43.20	49.60	
250		32.50	37.25	40.80	45.20	54.00	62.00	
300		39.00	44.70	48.90	54.30	64.80	74.50	
350	12	45.50	52.20	57.10	63.40	75.60	86.80	
400		52.00	59.60	65.30	72.40	86.50	99.30	
450		58.50	67.10	73.40	81.50	97.20	111.50	
500		65.00	74.60	81.50	90.50	108.00	124.00	
	15							

CHIMNEY DIMENSIONS INCHES	Gross Areas Sq. Ft.	Gas Velocity
8 x 8	0.444	5
8 x 12	0.666	
12 x 12	1.00	
16 x 16	1.78	8
20 x 20	2.75	10
24 x 24	4.00	12
28 x 28	5.43	
32 x 32	7.14	15
36 x 36	9.00	

Note—Draft Resistance Due to Velocity

When the chimney height is above normal the chimney area can be reduced by increasing the above velocities in proportion to the excess resistance permitted by the excess height, per the following

Velocity ft. per sec.	Resistance (inches of water) to be deducted from Avail. Draft Table II in accordance with the corresponding increased velocity
5	.005 plus .00034 x height
10	.021 plus .00135 x height
15	.048 plus .00304 x height

The above resistances are calculated for minimum temperatures. At 1200° smokehood temperature the resistance is 50% of above.

TABLE II—CHIMNEY HEIGHTS

OUTSIDE TEMPERATURE	TEMPERATURE CHIMNEY GASES At Boiler Smokehood	Total Available Draft measured in inches of water at foot of Chimney for various Chimney Heights and outside temperatures						
		30 feet	40 feet	50 feet	60 feet	70 feet	80 feet	100 feet
0	300	0.065	0.086	0.108	0.130	0.151	0.173	0.216
	500	0.130	0.174	0.218	0.261	0.305	0.348	0.435
	700	0.179	0.238	0.298	0.358	0.417	0.477	0.596
	900	0.216	0.288	0.360	0.432	0.504	0.576	0.720
	1100	0.245	0.328	0.410	0.491	0.573	0.655	0.818
	1200	0.269	0.359	0.450	0.539	0.628	0.718	0.898
30	300	0.034	0.045	0.057	0.068	0.080	0.091	0.114
	450	0.100	0.133	0.166	0.200	0.233	0.266	0.333
	650	0.148	0.198	0.247	0.297	0.346	0.395	0.494
	850	0.185	0.247	0.309	0.370	0.432	0.494	0.618
	1000	0.215	0.286	0.358	0.430	0.502	0.572	0.716
	1100	0.239	0.318	0.398	0.478	0.557	0.637	0.796
50	300	0.016	0.021	0.026	0.032	0.037	0.042	0.053
	450	0.082	0.109	0.136	0.163	0.190	0.216	0.272
	650	0.130	0.173	0.216	0.260	0.303	0.346	0.433
	850	0.167	0.222	0.278	0.334	0.390	0.445	0.557
	1000	0.196	0.262	0.327	0.393	0.458	0.523	0.655
	1100	0.220	0 294	0.368	0.441	0.515	0.588	0.735
70	400			0.107				0.215
	600			0.188				0.376
	800			0.250				0.500
	900			0.299				0.598
	1000			0.393				0.786
80	600			0.175				0.350
	800			0.237				0.474
	1000			0.286				0.572

the table directly above the available draft.

Example. (a) 0°
(b) 600°
(c) 0.26 in.

The resultant height is 50 ft. It is found by interpolating 0.26 in. between 0.218 for 500° and 0.298 for 700° in 50-ft. column.

From these two tables the correct chimney proportions for the example have been determined as 16 in. x 20 in. x 50 ft.

A. E. S. C. Co-ordinating Pipe Standardization

Following a large amount of preliminary work in standardizing designs, dimensions, and materials for wrought-iron and wrought-steel pipe that has been carried on by the American Society for Testing Materials, American Society of Mechanical Engineers, National Committee on Metals Utilization and other national organizations, a movement to co-ordinate this work has been inaugurated by the American Engineering Standards Committee, with the formation of a special committee for this project headed by W. J. Serrill of the United Gas Improvement Co., Philadelphia, Pa. This committee recommended the following scope for the work:

"Standardization of the design, dimensions and material of welded wrought-iron pipe, of welded and seamless steel pipe, and of boiler tubing, including pipe and tubing for high temperatures and pressures."

It is proposed to carry on a comprehensive program of standardization with the American Society for Testing Materials and the American Society of Mechanical Engineers acting as sponsors. All available data will be placed in a common pool, and a representative sectional committee will be made up of delegates from every important interest concerned. This committee will begin to function as soon as it is formed.

1927 Year Book of American Engineering Standards Committee

Important progress in a dozen major industries is described in the year book of the American Engineering Standards Committee. An extremely wide range of work is covered, from standardization of threads for bolts and nuts to recommendations for rock dusting of coal mines; from specifications for railway ties to standards for methods of recording and compiling accident statistics. The number of projects has increased from 212 to 238, and the number of approved standards from 82 to 103, during the year. There are now approximately 2000 individuals serving on sectional committees of this organization, and these represent over 300 national co-operating bodies. A list of the member-bodies appears on the inside of the front cover.

From this issue it can be seen that substantial progress has been made in the standardization work on bolts, nuts and rivets. Other mechanical standards are rapidly formulating, as is shown in the nine sections on pipe flanges and fittings.

Twenty-four of the fifty safety codes recommended have been approved. In the National Electric Code, non-metallic sheathed cable for wiring devices has been approved for limited uses, settling a three-year controversy. The 80 pages in this book cover work under consideration or accomplished in standardization movements. A complete list of technical projects is found on pp. 27-50. A copy of the year book will be sent upon request to the American Engineering Standards Committee, 29 West 39th St., New York.

Power Show to Have Nearly 200 Exhibitors of Heating and Ventilating Apparatus

At the forthcoming Sixth National Exposition of Power and Mechanical Engineering, to be held December 5-10, at the Grand Central Palace, New York City, heating and air-conditioning appliances and their regulation will be shown and demonstrated by nearly 200 exhibitors. Several of the most important American engineering societies are co-operating in this event, including the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers. Both of these organizations are holding their annual meetings at the time of the exposition.

How Our English Cousins Do It

Entire Heating Plants Are Welded on the Job—How Repairs Are Made —Fabricating Radiation by Welding

DESIGNING and installing a "central" heating plant in England is vastly different from procedure in these United States, as may be judged from the following excerpts of a paper recently read before the British Acetylene and Welding Association, by J. L. Musgrave and W. A. E. Taylor, members of a prominent London firm, and published in the *Acetylene Journal* for September, 1927.

Not only is welding used in fabricating radiation and other elements, but entire heating plants of the "panel" system are literally built in place, making unit systems, with a minimum of pipe fitting as they are used in America. The portion of the paper of interest to American readers is as follows:

"In the year 1909 steps were taken by us to introduce oxy-acetylene welding into our business, and at that time, although realizing that this method would become a part of the heating engineer's plant, we did not foresee the immense value this process would be to us to-day.

"Oxy-acetylene and other processes of welding largely take the place of screwed fittings or flanged joints in an apparatus which is subject to high pressure, and when the engineer has to consider space and perhaps the appearance of his work. The heating engineer can surmount many difficulties by the use of the blow-pipe; if, for instance, it is necessary to obtain a certain superficial area of heating surface in a limited space which might be impossible if screwed joints had to used.

FABRICATING A HIGH CAPACITY RADIATOR FOR RESTRICTED SPACE

"For example, one of our customers required a heater of a certain dimension with a particularly limited free area between the tubes, the air to be heated to 220° F. The desired result was obtained by using the form of coil shown in Fig. 1.

"Each coil was tested by air pressure to 500 lbs. per sq. in., and in passing it may be mentioned that all joints welded in the shop are tested in this manner to this pressure.

"A number of these coils were assembled in a sheet-iron case, forming a complete battery, and connected together by means of welded headers for the steam and condensate. One can realize immediately the difficulty that would be experienced if screwed joints had been used.

"Fig. 2 illustrates the welded header used with this heater, and a similar header if screwed tees, bends and flanges had to be used.

"Heating or cooling pads, as shown in Fig. 3, are constructed out of 3/16 in. black sheets, galvanized after manufacture. These pads are worked at a very low pressure, hot water or brine circulating through them. No distortion takes place during the process of acetylene welding and the welding at the edge, as shown, produces a very clean and sound joint.

FABRICATING A PANEL-SYSTEM HEATING PLANT ON THE JOB

"The development of the patented method of warming, known as the 'panel' system, would have been hampered seriously without the assistance of oxy-acetylene welding.

"Frequently, in large buildings, every joint in the system above the basement level is welded by the oxy-acetylene process, with the exception of the coils, which are made in the shop in standard sizes.

"It might be interesting to show you two standard types, one type made by oxy-acetylene welding and the other type by electric welding and bending. The first type is a wall coil as shown in Fig. 4.

The coils are made from $\frac{1}{2}$-in. or $\frac{3}{4}$-in. tubing in varying lengths and widths. The frame of the coil is bent and welded first, holes already having been drilled in the top and bottom tubes. This frame is then fixed in a jig, a welder working at each end of the coil. To save any possibility of the coils distorting, channel frames are fixed to the coils at the top and bottom, and this method proves very successful in practice. Only experienced welders are allowed to carry out this work, as it is important that the bore of the pipe should be free from any welding metal projecting into the inside. After welding, the coils are tested on a flat plate as they must be dead true.

"Where coils are to be fixed in ceilings for heating, a continuous type is adopted, as shown in Fig. 5.

"The joints of these coils are electrically welded. A brief description of how these coils are made may be of interest. They are manufactured in four standard sizes, thereby making it possible to use only two lengths of tube. 18 ft. 2½ in. and 15 ft. 4¾ in., these lengths being suitable for the four standard types required.

"The first operation is the grinding or cleaning of the ends and periphery of the tube, which is necessary to in-

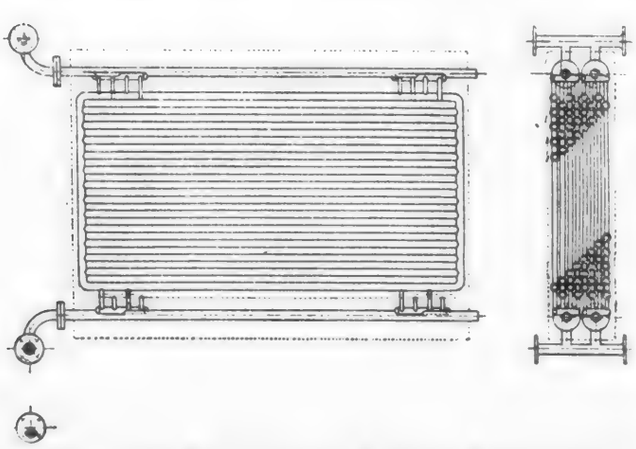


Fig. 1. English Concentrated Heater Fabricated by Oxy-acetylene Welding

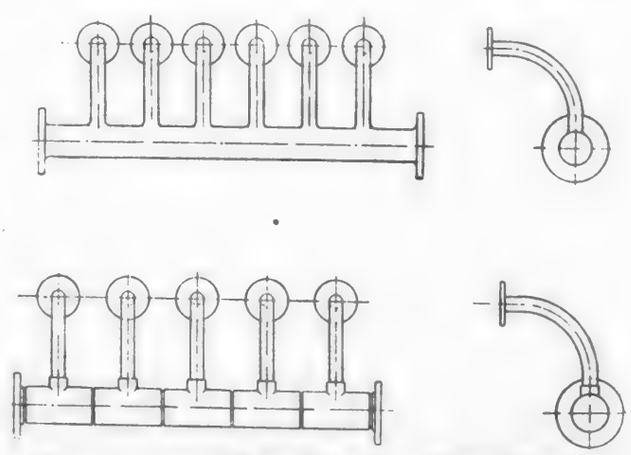


Fig. 2. (Above) Welded Header. (Below) Similar Header Built Up From Fittings

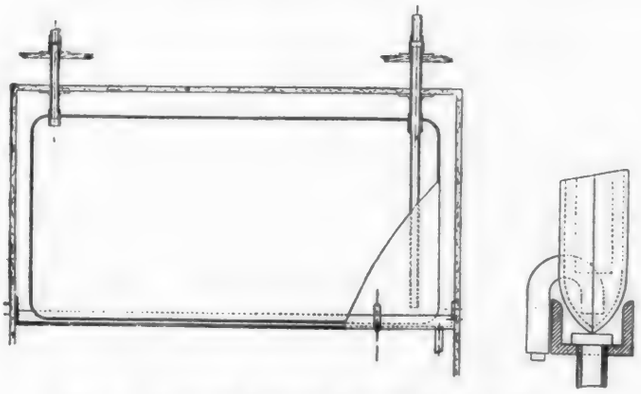


Fig. 3. Typical English Welded Pad for Space Heating or Cooling

sure perfect contact between the tube and the vise-jaws of the bending and welding machines.

"The operation of bending is carried out by a machine, especially designed for making the bends with an external radius of 2 7/16 in., which gives 4-in. centers to the spacing of the complete coils.

ELECTRIC-WELDING COIL UNITS

"Two pairs of copper vise-jaws (actually the positive and negative of the secondary circuit), radiused to take this size tube, and served by a continuous water-cooling circuit, are employed, one pair being rigid to hold the material in position and the second pair being made to swivel downwards on being released, thus leaving the way clear for the roller of the bending arm to rotate on its axis. The tube is heated to a blood red heat for a length of 8¾ in., just sufficient to allow for the forming of the actual bend or syphon head. The average time for making one bend is 45 seconds, and the current used is 0.2 K.W.H. The coil sections when bent are hung vertically upon hooks within easy reach of the welder.

"By the use of a trip switch, the two ends are brought up to the correct welding heat, a constant pressure being maintained on the operating lever to insure perfect contact between the two ends at which point the highest temperature is obtained and when the correct degree is reached further pressure is exerted upon the lever, thereby forcing the ends together and completing the weld at the same time. This upsets the ends and prevents any protrusion of metal inside the tube.

"While still at welding heat, swaging tongs are brought into use and partially rotated round the joint, pressing the upset ends into shape. The time taken for one weld is approximately 55 seconds and the amount of current used is 0.26 K.W.H.

INSTALLING COILS IN CONCRETE FLOORS

"After delivery to the site, the coils, the manufacture of which is described above, are usually cast in the underside of concrete floors in order to warm the room below by radiation from the ceiling.

"The coils are clipped to the forms prior to the concrete being poured, the ends being connected to flow and return risers by branches oxy-acetylene welded to both coils and risers, the whole being subjected for about six hours to a hydraulic pressure of 200 lbs. per square inch.

"The time during which the test pressure is maintained is of considerable importance, and a careful examination of the joints is necessary before the pressure is released to eliminate the risk of minute hair cracks passing unnoticed. This might easily happen if the test is applied for only a short period.

"Frequently, where structural conditions permit, the flow and return risers as well as the panel coils are cast solid into the concrete, the whole forming one homogeneous part of the structure. Obviously, access to the joints afterwards is difficult, hence the greatest care has to be observed that all joints are sound before the work is closed in.

"Careful observations and tests have shown that the stresses of expansion and contraction due to variations of temperature in the warming fluid passing through the pipes are within the elastic limit of the metal; hence when the pipes are hot the metal is under a slight compressive strain and when cold, probably a slight tension is set up.

"On very rare occasions, minute defects in coils cast in concrete have developed, necessitating repair. The method adopted is indicated in Fig. 6.

"The defect, which may be due to a hair crack, is discovered by a small damp patch in the ceiling. The plaster is cut away and the defective piece cut out by a cutting blow-pipe, the fixed ends then being beveled off as shown in the sketch, the filling-in piece being similarly beveled and tacked into position and the uppermost half of the periphery of one end of the pipe filled in with welding metal. A saddle piece, previously shaped, is then welded in to fill the lower half. When the first weld has cooled, the other end is then welded in the same manner and the repair is allowed to cool down gradually by playing the blow-pipe on the exposed portion for decreasing periods of time. The filling up of the hole by cement and plaster is a comparatively simple matter, the whole operation being carried out in a few hours.

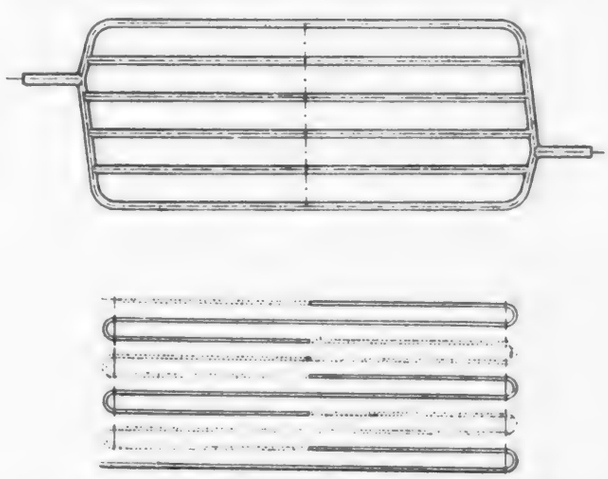
UNIT-WELDED SYSTEMS GIVE SATISFACTION

"The reliability of the oxy-acetylene process, if carefully carried out, is proved by the results of the tests on three buildings, the contracts for which were carried out simultaneously.

"There were 4,341 panel coils, comprising 270,000 ft. or 51 miles of pipe. 23,404 bends, with 15,850 electric welds. The approximate length of pipe used in addition to the panel coils was 125,800 ft. or about 24 miles with oxy-acetylene welds numbering about 13,000.

"So far not one leak has developed after work has been cast in. Two of the systems have had two seasons' use; the third, owing to delay in completion of the building, has not yet been subjected to heat, but has stood filled with water for a long period.

"The difficulties that would confront the architect and the builder if screwed



Figs. 4 and 5. How the English Fabricate Heating Coils on the Job to be Embedded in Floor and Ceiling Concrete Construction

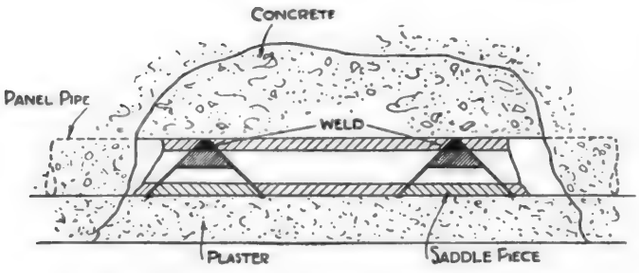


Fig. 6. Repairing Leak in a Coil in English System of Construction

joints had been used on these buildings, necessitating means of access to the above-mentioned number of joints, will be readily imagined, whereas by the use of the oxy-acetylene process pipes may be stowed away safely in inaccessible positions, greatly simplifying the work of the heating engineer, as well as other parties concerned and the cost of maintenance is greatly reduced."

New Committee Will Prepare Refrigeration Code

Following the procedure of the American Engineering Standards Committee, and under the sponsorship of the American Society of Refrigerating Engineers, a subcommittee has been formed to redraft portions of the code dealing with safety requirements for mechanical refrigeration.

The code deals with refrigeration equipment classified as to capacity under three divisions, and further divided as to working medium or refrigerant employed. The section of the code about which most question has been raised is that dealing with small machines for household and similar uses.

H. D. Edwards is chairman of the subcommittee, and P. E. Mathews of the sectional committee.

Officials of New National Radiator Corporation Meet

For the first time since announcement of the formation of the National Radiator Corporation, heads of six radiator and boiler companies of the east recently met in Johnstown, Pa., to discuss policies and plans for the future.

The entire day and evening were devoted to discussion of the company's program. All those present expressed their satisfaction at the merger and their confidence that the new corporation will attain a degree of success even greater than the constituent companies had won.

The photograph shows from left to right, in the front row: E. C. Andrews, president of Niagara Radiator and Boiler Co., North Tonawanda, N. Y., now chairman of the advisory committee of the new corporation; Senator Herman E. Baumer, treasurer and general manager of Union Radiator Co., Johnstown; John H. Waters, president of National Radiator Co., Johnstown, now chairman of the board of directors of National Radiator Corporation; John W. Watson, president of Continental Heater Corp., Dunkirk, N. Y., and E. H. Gurney, president of Gurney Heater Mfg. Co., Boston, Mass.

In the rear row are shown: Robert S. Waters, secretary of National Radiator Company; E. C. Reed, vice-president of Continental Heater Corporation; James K. Norris, vice-president of Utica Heater Co., Utica, N. Y.; Samuel B. Waters, vice-president and treasurer of National Radiator Company; Charles L. Crouse, vice-president and general manager of plant sales, National Radiator Company; W. W. Wetmore, vice-president and treasurer, Niagara Radiator and Boiler Company; Carl E. Resley, vice-president and comptroller, National Radiator Company; R. E. Warden, vice-president in charge of sales, National Radiator Company.

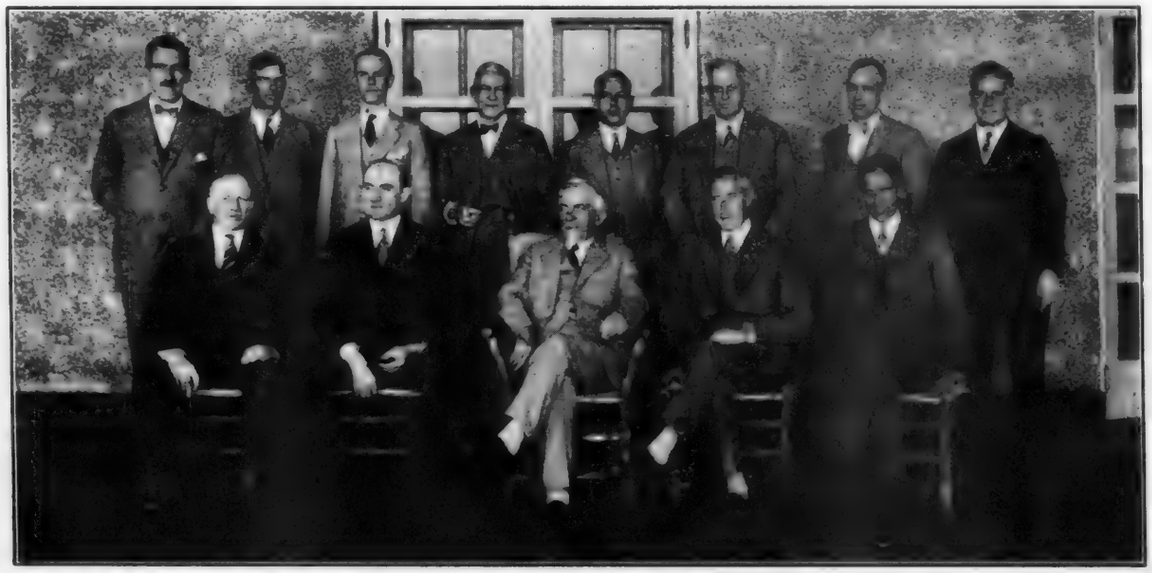
Edward Norris, president of Utica Heater Company, and president of the new corporation, was unable to be present on account of illness.

Conference on Engineering Materials in Berlin

Preparations are being made for the Conference on Engineering Materials in Berlin, October 22 to November 13, and the program of papers contains about 200 lectures to be read by scientists and practical engineers. While these papers, which are to be read at the Technical University of Charlottenburg, are intended chiefly for engineers, an exhibition of engineering materials arranged in the Neue Ausstellungshalle on the Kaiserdamm also will be an attraction for the general public.

Three groups of engineering materials will be dealt with, namely, iron and steel, non-ferrous metals, and electrical insulation materials, and at one of the sessions materials for heating and power plants will be discussed.

Sponsors of this convention are the German scientific engineering associations, supported by various German industrial organizations and the exhibitions and foreign visitors office of the city of Berlin.



Executives of National Radiator Corporation

Boiler Compounds and Liquids

Methods of Using the Many Chemicals Available for Water Conditioning, Scale Removal and Leak Stoppage

YEARS ago there was nothing to do when a heating boiler gave trouble in a new job but to boil it out with soda. This was as unfailing and old-fashioned a remedy as the sulphur and molasses which used to be grandmother's panacea for all ills to which childhood fell heir. And the washing soda treatment did produce results—so did the sulphur and molasses, for that matter. Nowhere is this more evidenced than in the heating industry where the new, the novel and, even the bizarre, have come to intrude with such regularity as to be expected.

Among the newer developments in connection with heating has been the rise in recent years of boiler liquids and compounds. These have gradually increased both in number and purpose until there is fluid for almost every boiler ill caused by oil, dirt, scale and even leaks due to imperfections or cracked sections.

CLASSIFICATION OF BOILER COMPOUNDS

These compounds or mixtures are divisible into three general classes: First, those intended to be placed in a new system for the purpose of removing the initial impurities from the boiler and the boiler water; second, those intended to remove scale and other impurities which are the result of long periods of operation and accumulation; and, third, those which are for the purpose of stopping leaks.

Those falling in the first category are the ones which really take the place of the old washing soda treatment, while those in the second and third classes enter into new fields never approached by the soda formerly used. Soda was a good treatment for oil in a boiler but, beyond that, little can be offered in its favor. Of course, some of the newer boiler compounds are not strictly limited to one type of service; that is to say, they may have characteristics which make them particularly useful for some purposes and, at the same time, they may be capable of giving beneficial results along other lines as well. For instance, a compound prepared especially to remove impurities in a new system may also help out an old system that has been filled up with rust and scale, and a compound prepared especially for use in loosening up scale may help out a new system where scale has not yet had time to form.

STOPPING LEAKS IN BOILERS AND RADIATORS

There is no doubt that the compounds which plug up leaks in boilers have saved owners thousands of dollars in boiler repairs. Even cracked sections have been made permanently tight without cutting the boiler out of service and in cases where the water was running out in sufficient quantity to put out the boiler fire.

As a typical instance, a manufacturer of one make of compound quotes the following case which occurred some time ago in a small town near New York:

About three o'clock in the morning a steamfitter was awakened by the terrified ringing of the telephone. On answering he was advised that, in the excitement attending the impending arrival of a new member of the family, the boiler apparently had been neglected or else had selected that particular moment to crack a section. It was too late to remove the mother to a hospital and the night was bitter cold; the house temperature had begun to fall and very serious consequences were likely to result to at least two people.

Steamfitters are human and this man happened to be a father himself so he assured the half-frantic man on the other end of the wire that all would be well and not to worry. Taking a can of compound with him he made a dash for the house, toward which the stork was even then on his way, and in a remarkably short time had raised steam in the boiler and the leak in the cracked section practically stopped. The bill when he sent it in later was paid without a kick and it was not a small bill, either.

COMPOUND QUIETS NOISY SYSTEM

In another instance a contractor had completed a job apparently in apple-pie order but, on firing up the boilers, all sorts of trouble developed, including water-hammer, foaming and loss of water. Several boilings-out with soda seemed to help the trouble temporarily but in a short time the system was back at its old tricks. Final payment was held up, everyone began talking about that job where there must be something wrong, connections were changed, and a lot of needless time and money were spent. Finally one of the contractor's friends suggested that he try, as an experiment, a certain boiler compound. This was done as a last resort and the system immediately settled down to business and no more trouble was experienced. If he had used this compound first, instead of last, he would have saved a lot of money, his reputation to-day would be better than it is and no complaints would have been made.

From the foregoing it is evident that boiler liquids are not only here to stay but are filling a long-felt want; that they are time and money-savers when properly applied and everyone in the heating industry should be familiar with their use. Every new system will be better for having had a good treatment of boiler compound when it is put into service and it is not necessary to replace a boiler section when it cracks or to tear the work apart in an endeavor to stop a leak. Also periodic treatment of old heating systems with compounds especially developed for this purpose will result in more satisfactory service, to say nothing of greater fuel economy.

Osaka Desires Information Regarding American Products

Osaka Municipal Office of the Department of Commerce and Industry, Osaka, Japan, announces that it is planning to hold an exhibition of advertising novelties and would like to receive those of home and foreign origin, as may be prepared by American concerns for demonstration of firm names or specialties. It is stated that Osaka is the largest distributing and manufacturing centre of Japan with a population of 2,200,000.

Any samples sent for the purpose of exhibition will be returned, if desired, at the expense of the department in Japan. All samples must carry an advertisement on them.

"Directory of Exporters and Importers of Osaka" for 1927 has been published, and a copy will be sent free of charge upon application to the Osaka Municipal Office.

Correspondence

Conducted by T. W. Reynolds

Preventing Excess Drafts in Cold-Air Intakes

EDITOR HEATING AND VENTILATING MAGAZINE:

We have had some difficulty with a gravity warm-air indirect heating system where the cold-air entrance is on

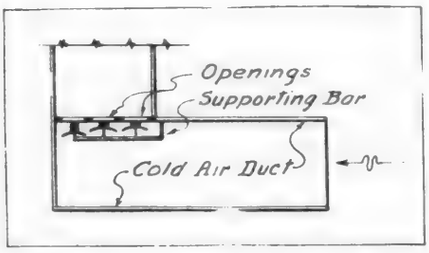


Fig. 1. Method of Preventing Excess Drafts in Vertical Duct

the north side of the house. When the winds are strong from this direction they blow readily through this entrance with the result that the radiators nearest this entrance do not heat.

Perhaps you can suggest some method which will permit the passage of air in the required volume, yet stop too great a passage of air as caused by sudden gusts of wind.

SUMMER L. WILLSON.
Thompsonville, Conn.

Two cold-air inlets, one on each side of the house, sometimes have been used in an effort to overcome the difficulties described. In such cases it is usually found that sudden blasts of air will enter one of these inlets, travel straight through, and then pass out of the other inlet, at the same time inducing a downward flow of warm air from the radiators, which air is blown out of one of the inlets.

Sometimes the difficulties can be overcome by recirculating, say, one-third of the air requirements, in which case the cold-air intake should be correspondingly reduced in size or else throttled by means of a damper because of the smaller amount of cold air required. Cold blasts of air then would be considerably lessened in volume.

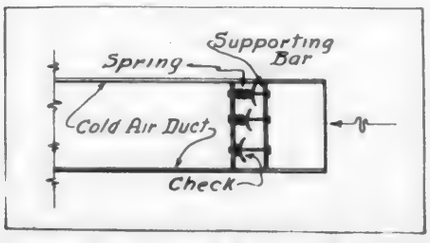


Fig. 2. Method of Preventing Excess Drafts in Horizontal Duct

It is entirely possible, of course, to control a damper in the cold-air duct by means of a room thermostat, in the same way as dampers on the house heater now often are controlled. Such a method probably would not be sensitive enough to give the degree of response required.

Figs. 1 to 3 show various methods which may be used and modified according to the conditions, in order to obtain the desired results. Checks of some light material, such as aluminum or cloth, may be used in any of these methods, remembering that cloth of a permeable nature will still admit a certain amount of air as may be desired when the checks temporarily are held in the closed position. Any of these methods, to be effective, require the removal and cleansing of metal-working parts, otherwise the parts become gummed up and do not work properly.

Fig. 1 shows a form of ventilator sometimes used at windows. Normally the checks remain open for the passage of air, due to the force of gravity, but sudden drafts of air will lift the checks to the closed position.

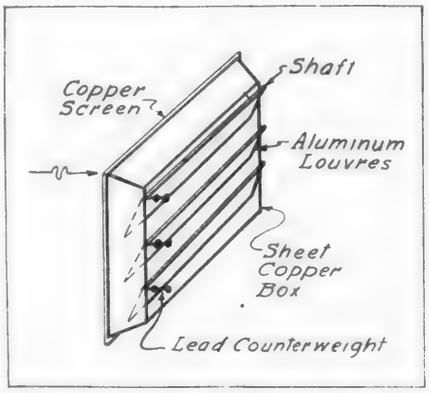


Fig. 3. Form of Ventilator with Counter-Weighted Louvres

Fig. 2 shows the same form of ventilator as illustrated in Fig. 1, the only difference being its position in a horizontal duct, instead of in a vertical one. In each case a supporting bar secures a number of rods or guides upon which light aluminum checks work backward or forward or up and down against the tension of springs. These springs are given various degrees of adjustment so that the number of openings closed by checks at any time depends upon the pressure of the wind. The greater the pressure, the greater the number of openings closed.

Fig. 3 shows another form of window ventilator. The principle upon which these ventilators operate is that of counter-balanced louvers, which normally are held open by lead counter-weights when there is no wind, but closing against a breeze strong enough to lift the counter-weights, thus shutting out drafts. When closed, however, they are not air-tight, but still admit sufficient air at reduced velocity to maintain circulation.

The counter-weights, which are made adjustable, so as to control the sensitiveness of the louvers to the action of the wind, are threaded on the extension of the shaft, shown bent at right angles. When the weights are placed near the axis of the shaft, they cause the louvers to close with the slightest wind pressure, but when moved toward the end of the shaft, the resistance of the louvers correspondingly is increased. Added resistance also may be obtained by increasing the number of weights, so as to hold the louvers open, as might be desired under certain conditions.

Fig. 3 illustrates the insert of the ventilator as marketed by the manufacturer, a separate unit, 7 in. x 9 in., consisting of a copper frame mounting three aluminum louvers on brass pivots revolving in copper bearings. These ventilators are made in several arrangements to suit conditions.

Salient Points in the Heating and Ventilation of Theaters

EDITOR HEATING AND VENTILATING MAGAZINE:

Will you kindly advise an up-to-date method of determining the following for theaters equipped with:

1—Mechanical exhausters only.

2—Mechanical supply with heating stacks and recirculation and mechanical exhausters.

3—Mechanical supply with heating stacks and mechanical exhausters.

In Case 1, the amount of radiation (cast-iron), required in addition to that compensating for wall, glass, and roof losses.

In Cases 2 and 3, the amount of radiation (cast-iron), required in addition to that compensating for wall, glass and roof losses, also the size of the stacks for the air supply.

DAN D. GARDNER.
East Orange, N. J.

No. 1—Air discharged by the exhaust system will be replaced by an equal amount of infiltration, hence the complete air changes resulting therefrom should be compensated for by sufficient direct radiation to raise this amount of air from the entering temperature to the temperature desired, radiation to be distributed and concentrated at points

where the greatest losses occur. No. 1 is an unusual method.

No. 2—No direct radiation is required other than that necessary because of losses through wall, glass and roof or similar exposures, as the recirculated air will be sufficient for all air requirements. The introduction of more air than that exhausted produces a plenum effect, which prevents infiltration.

Such a system or method may be modified so as to omit the exhaust fan or fans entirely, in this case dependence being placed as before upon recirculation. Excess air will then be discharged through various exhaust openings, due to the plenum effect.

The size of heaters will vary with the size of the job, that is, according to the number of occupants and the air supply per occupant which in turn may range anywhere from 15 to 30 C.F.M. per person, depending upon the conditions. In order to determine the size of these heaters, a temperature of, say, 55° F. is predetermined at the inlet side of the air heaters, which temperature is maintained by means of thermostatically-controlled dampers in recirculation and outside air ducts.

A temperature rise of 30° through the heaters will introduce air at the proper temperature into the theater. A thermostat on balcony rail or other convenient point should control the by-pass damper under the heaters as well as the valves admitting steam to these heaters.

No. 3—The method of procedure should be the same as for No. 2, except that the air heaters should be designed for air entering at 0° F. and leaving at approximately 83° F., with the same control as before on the balcony. Mechanical exhaust cannot be dispensed with under this system.

The foregoing remarks refer to the auditorium, stage and other rooms being differently treated. Most stages are about six stories high. The warm air rises around the outer walls, crosses on the ceiling, where it is cooled, and then falls down in a cascade of chilly air to the top of the proscenium arch, where it spreads out into the auditorium and drops onto the forward seats in the orchestra.

Of course, the stage heat loss should be figured for the walls, roof and skylight in the regular way, but the number of air changes assumed per hour is entirely arbitrary. Not less than one air change should be figured and sometimes even this is too little. At times when the curtain is raised for performances, the amount of heat as above computed may be too high, so it is very desirable to control the stage radiators by means of thermostats.

In the morning, when the cleaners and theater employees are working, the stage heat will be sufficient to temper the auditorium without the use of the fan.

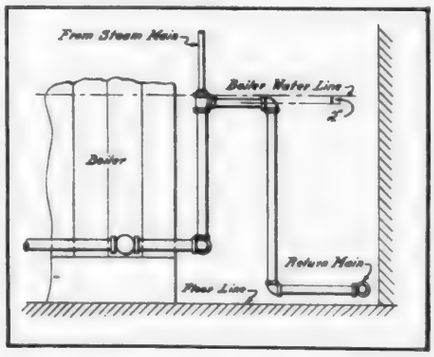
In most theater designs there are two stairways leading to the boxes, one at either side of the auditorium, near the proscenium arch. A cold current of air falls at these points and should be neutralized or counteracted in some manner by means of direct radiators. If there are long passages to the exit doors from the auditorium, these passages should also be warmed with direct radiators.

For further information on the subject of theater heating and ventilation, the reader is referred to THE HEATING AND VENTILATING MAGAZINE for March and April, 1927.

Underwriters' Loop

EDITOR HEATING AND VENTILATING MAGAZINE:

I am just in receipt of September HEATING AND VENTILATING MAGAZINE and the first thing that struck my eye was Fig. 63, Page 78, which appears to be



Correct Connection of Underwriters' Loop

an attempt to illustrate the Underwriters' return connection to a low-pressure heating boiler.

Whoever made this illustration overlooked one very important feature. He illustrates the equalizing pipe as coming from the steam main. This should come from the top of the boiler and is usually taken from the branch from the boiler to the header between the boiler and main shut-off valve.

If somebody shut off the main supply valve on the boiler connected up in accordance with your sketch, it would take very little fire in the boiler to drive all the water out of it.

The proper illustration for this connection can be secured from the Heating and Piping Contractors National Association or the American Society of Heating and Ventilating Engineers' *Guide*.

Chicago, Ill. H. M. H.

Our correspondent apparently has assumed that "steam main," as given, indicates the steam *to the building*, instead of the steam main *to the boiler*. Reference to the text, however, will make this clear. This connection may be run to an equalizer pipe between the boilers, to the steam main from the boiler, as stated, or may be connected direct to the steam space in the boiler; the only essential is that there should not be any valves which could be closed off in the piping between the point of connection and the boiler.

The Proper Elevation of the Dry Return Above the Boiler Water Line

EDITOR HEATING AND VENTILATING MAGAZINE:

Will you kindly explain the method used in figuring the distance required above the boiler water-line?

Paterson, N. J. JOHN KNOWLES.

The proper elevation of the piping above the boiler water-line depends upon the allowable pressure-drop which, in turn, depends upon several factors, such as the pressure to be carried by the boiler, the pressure at the end of the system (for example, the pressure required to operate the air valves), the additional tax upon the heating system during warming-up periods, and the elimination of noise and holding up of condensate whenever the pressure-drop is rather high, due to small pipes as designed for higher velocities.

From experience it has been found that a heating system will operate most satisfactorily with a low boiler pressure and slight drop in pressure and that the system should be designed so as to operate with the lowest pressure carried by the boiler. During the warming-up period the steam requirements may be three times as great as under normal conditions, especially where the system vents itself quickly as in a vapor system, though more particularly as in vacuum systems. However, though this extra demand should be taken into account, the allowance need not be for any amount as great as the above 300% because, as the demand exceeds the supply, the pressure will drop, causing a reduction in the supply; in other words, the demand and supply are to a certain extent self-regulating.

Higher pressure-drop and smaller pipe may be used where constant conditions of initial pressure are maintained, as with a pressure-reducing valve; wherever the system is quick venting, as in systems having a mechanical vacuum return line, and in any building the character of which requires relatively slow heating up periods. In vacuum systems the total drop from boiler to farthest radiator should be that between available initial and atmospheric pressure so that normally the pressure in the radiator will be at or slightly below that of the atmosphere.

As a general rule, the initial pressure in any system should not exceed 1 lb.

and the pressure drop per 100 ft. of straight pipe or its equivalent length should not be over 1 oz. with a still lower drop where the runs are rather long. In small buildings, such as dwellings where the longest run is usually under 200 ft. and in which the steam and return mains are of such a size that the drop in pressure is not greater than 1 oz. in 100 ft., the total pressure-drop should not be over 2 oz. In larger buildings, not excepting skyscrapers, the total pressure-drop should never be over 8 oz.

The distance between the lowest point of the dry return and the boiler water-line should be at least 24 in. in order to provide for the excessive drop in pressure when heating up a cold system. This distance should be increased 2 in. for every ounce of pressure drop in the system. Thus, if the total pressure drop were 2 oz., as in residences, the water-line difference should be (2X2) + 24, or 28 in. However, such systems often work satisfactorily when this distance is only 18 in., due to various factors such as pressure-drop as obtained with the use of large pipes.

The important point is always to get as much distance as possible above the water-line for the vertical head of water to overcome the pressure in the boiler, as the pressure is often raised much higher in operation than was figured upon. Then again there is the loss of pressure* in lifting the flaps of check valves on the return at the boilers, and these sometimes open only with considerable pressure after being in service for a time.

In vapor systems the distance above water-line is often fixed by the manufacturer of the specialties used, quite often a minimum distance of 30 in. being specified. This minimum is desired in order to insure that the elevation of water in the return will not reach and close the vent outlet of the air trap at the boilers. This requirement however, is not as important as it is to have the dry return and supply piping well above the boiler water-line, because whenever the water rises to close the vent outlet an air pressure will soon accumulate in the vent trap, due to closing of the vent outlet which, under usual conditions, is sufficient, together with the hydrostatic head of water, to overcome the resistance of the boiler pressure.

*The vertical head required is seldom less than 3 in. with the clapper at an angle of 10 deg. from the vertical and may run up to 18 in. and higher with vertical lift valve pieces. This varies with the make, weight and angle of the clapper and size of pipe tapping.

Roof Ventilators Should Be Ample in Size

EDITOR HEATING AND VENTILATING MAGAZINE:

The proper procedure and calculation to determine the number and size of roof ventilators for a building or room, in order to procure specific results, have been published and advocated in such varied form and with such questionable results, that confusion reigns in the minds of the public and building owners as to the good or bad in roof ventilation as a whole. In an effort to promote sales of some particular make or type of ventilator, the trend of recommendations is for fewer or smaller-sized ventilators where larger should be used. This, if judged from the fact that few are satisfactory, and the overventilated building being exceptional, leads to the belief that these lines of procedure do not accrue to the public confidence or to the great advancement in building sanitation necessary to the progress in this line.

Further, the improvements in roof ventilators' exhaust from natural agencies in the last twenty years has not been such as to warrant decreasing quantities or sizes to be used, as now advocated, when size and occupants of all buildings are being increased.

All former calculations of size roof ventilators required were based on 1 sq. in. of ventilator area to 1 sq. ft. of floor space, and this appears nearer a satisfactory working basis than present practice in view of the fact that the amount of ventilation, if too great, may be automatically or manually regulated through damper, when it is desired. This would give better results, makes a flexible system and would be more to our roof ventilator needs this day.

Philadelphia, Pa. W. H. JARDINE.

Sampling and Analysis of Gases

A compendium of methods, used by the chemists of the subsidiary companies of the United States Steel Corporation in sampling and analyzing gases, has resulted from more than two years' work by a special committee of the chief chemists of these companies.

Although the scope of this volume far over-reaches the bounds of analysis as carried out in connection with combustion problems, yet the portions dealing with flue-gas analysis are so comprehensive and modern that the treatise is valuable to all who have cause to deal with this phase of gas analysis.

The preliminary section deals with apparatus, reagents and absorbing solutions, and describes many interesting modifications of standard Orsat and other equipment. A following section sets forth methods of sampling and analysis as standardized by the chemists of the corporation. A third section deals with determinations that require special apparatus, and the last portion of the text outlines methods of determining gas volumes under different conditions. An appendix includes a number of standard tables coming within the scope of the volume.

This excellent treatise may be had from the Bureau of Instruction, Carnegie Steel Co., Pittsburgh, for $2. The volume is 6 in. x 9 in., with 187 pages and 25 illustrations.

Honeywell Holds Its Annual Picnic

For the second time an annual social gathering of the Honeywell Heating Specialties Co., Wabash, Ind., took the form of a picnic. Held Aug. 20, at Myrtle Glen Park, Silver Lake, Ind., nearly 900 employees of the company participated in dancing, indoor baseball and other athletic sports.

Stimulated by a generous array of prizes, the contests were hotly contested by so many entries that elimination heats were run in every event.

Outing of Employees of Honeywell Heating Specialties Company

AIR CONDITIONING

Wet-Bulb Temperature of Air Mixtures

Data Sheet No. 20-F gives the total heat content of air for corresponding wet-bulb temperatures. It is useful in solving problems involving the resultant wet-bulb temperature of air mixtures.

Example: Consider that 3000 lbs. of recirculated air per minute, with a wet-bulb temperature of 65° F., mixes with 1000 lbs. of outdoor air per minute at 75° F. wet-bulb, and that this mixture passes through an air cooler capable of completely saturating to a temperature of 60° F. at the cooler outlet. What is the refrigeration tonnage required?

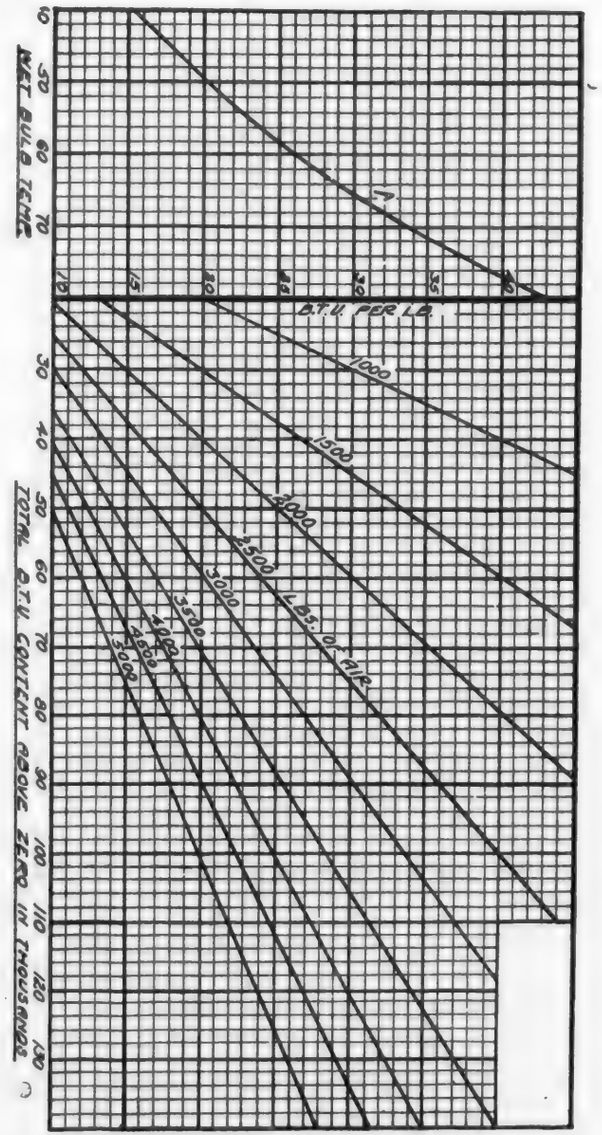
First, locate 65° on the horizontal wet-bulb scale at the left portion of the chart. Pass vertically to the curved line (A) and then from this point of intersection pass horizontally to the right to the 3000-lb. line. From this point drop vertically to the base line, which is the B.T.U. content scale, and read 88,500. Similarly, locate 75° wet-bulb, pass to curve A, then to the 1000-lb. line and down to the base line, and read 38,000 on the B.T.U. content line. The sum of 88,500 and 38,000 is 126,500 B.T.U., and the foregoing procedure must be reversed to find the wet-bulb temperature corresponding. Locate this value on the B.T.U. scale, pass vertically upward to the diagonal 4000-lb. line (total weight of mixture), then horizontally to the left to curve A. From this point drop vertically to the wet-bulb scale and read 67½°, which is the wet-bulb temperature of the mixture entering the cooler. At this wet-bulb temperature, 1 lb. of air contains 31.6 B.T.U. This is determined by following upward from the 67½° point on the base line to an intersection with curve A; then passing on a horizontal line to the vertical scale giving B.T.U. per pound.

In the same way, a temperature of 60° F. saturated at the cooler outlet corresponds to 26.2 B.T.U. per pound. Therefore, for each pound of air passing through the cooler, there must be removed the difference between 31.6 and 26.2, or 5.4 B.T.U. Multiplying by 4000, the total weight of air handled, gives 21,600 B.T.U. Dividing this value by 200 B.T.U. per minute (the heat equivalent of one ton of refrigeration), gives 108 tons of refrigeration required to maintain the conditions stated.

O. W. Armspach.

AIR CONDITIONING—How to Use Chart of Wet-Bulb Temperature of Air Mixtures | No. 20-G

AIR CONDITIONING



AIR CONDITIONING—Wet-Bulb Temperature of Air Mixtures | No. 20-F

Heating Plants as the Subject of Mechanics' Liens

By John Simpson

A MECHANIC'S lien is a right or privilege given to a contractor to protect himself against loss for material and labor furnished. It is entirely a statutory right, and the contractor may waive such a lien by contract. A contract stipulation waiving the lien, however, must be explicit to bind the contractor, and any doubt and ambiguity would be resolved in favor of the lien.

A stipulation in a contract for the furnishing and installation of plumbing and heating in a building that: "The said contractor hereby waives all liens and claims to liens against the said building and the land on which the same is erected which he . . . may have or be entitled to under and by virtue of the statutes of the State of Iowa by reason of work done and to be done and material furnished and to be furnished said building under this contract," was held to be perfectly clear and unambiguous in every respect, and binding on the contractor. Van Dyck Heating & Plumbing Co. v. Central Iowa Bldg. Co. Iowa 205 N. W. 650.

The Kansas Supreme Court holds, Eggleston v. White Kan. 214 Pac. 623, that the basis of a mechanic's lien is the contract with the owner of the property to be improved, and, while a subcontractor is not bound by all the terms of the contract with the owner, he must take notice of and is bound by such of the specifications of the contract as relate to and describe the particular materials which he undertakes to furnish. Where, therefore, a building contractor and a subcontractor for the installing of a heating plant entered into an agreement by which the heating contractor installed a warm-air furnace with a 22-in. fire pot inadequate for heating the house, when the contract with the owner, which the heating contractor had not examined and of the requirements of which he had no definite knowledge, required a 24-in. fire pot, he was not entitled to foreclose a direct lien under the Kansas statute against the owner's land, although he might enforce his claim against the contractor.

"FIXTURES" AND "MACHINES"

A boiler put in a house in place of an old one used for heating the house was held, within the meaning of the Minnesota Mechanics' lien statute, material for "repairing" the house, as it supplied the place of the old one worn out, and it was also both a "fixture" and "machine." If none of these things, it would be an "improvement" of the property within the act, "for it is a permanent and necessary part of the building." Menne v. American Radiator Co., 150 Ky. 151, 150 S. W. 24.

A tenant made some improvements resulting in mechanics' liens being filed therefor under the Minnesota statute. One was for a combined steam heating and power plant consisting of an engine, a boiler and connecting pipes, coil radiators in the basement, the usual steam radiators on the first and second floors, connected with the boiler with the usual piping, screwed, flanged to the boiler and screwed to the radiators, the pipes in the basement being also nailed or screwed to floor joists. There were the usual elbows, couplings, valves, traps and fittings incident to a steam heating plant. It was held it was not necessary to consider whether, as between landlord and tenant, the plant was a "trade fixture," because "in no case can the tenant remove fixtures, no matter what the purpose for which they were installed, if they are permanent in their nature and if their removal will leave the freehold in a substantially worse plight than before the annexation was made," and the trial court's finding that the heating and power plant "was so connected as to make the same and all thereof a part of the land and premises" was held sustained by the evidence, since its nature, its mode of annexation, and its purpose and use, were such as to place it within the class of permanent improvements, and its removal could not be effected without substantial impairment of the freehold." A lien was allowed therefor. Northwestern Lumber & W. Co. v. Parker, 125 Minn. 107, 145 N. W. 964.

A furnace for heating the house, set within a brick structure and the connecting pipes and appurtenances throughout the house became a part of the realty and the contractor furnishing and installing the apparatus had a lien therefor under N. Y. Laws 1885, C. 342, Sec. 1. Schwartz v. Allen, 7 N. Y. Supp. 5.

A mechanic's lien against a house was allowed under the Maryland act for a furnace, range and warm-air fixtures furnished by the plaintiffs and used in the construction of the house Weber v. Weatherby, 34 Md. 661. And in Schaper v. Bibb, 71 Md. 150. it was held that, for the same reason that the lien exists for ranges and furnaces it should exist for fireplace heaters, pipes, registers, etc., fitted in the house as permanent fixtures.

A furnace put in a building to remain there permanently was held part of the realty and subject to a mechanic's lien. Thielman v. Carr, 75 Ill. 386. Goodwin v. Elleardsville Hall Assn., 5 Mo. App. 289.

WHEN HOUSE IS SOLD BEFORE COMPLETION OF INSTALLATION

The fact that the property was sold before the completion of the installation of a steam heating plant, with the necessary boilers, radiators, pipes, valves, etc., did not, it was held, affect the contractor's right to a lien therefor under the Missouri Mechanics' and Materialmen's Lien Laws. Having contracted with the former owners, and the work under the contract having commenced while they were owners, and completed after the sale, the contractor was not bound to take notice of subsequent conveyances. Brown v. Davis, (Mo. App.) 249 S. W. 696.

A steam heating apparatus, consisting of a boiler and furnace built in the cellar of a hotel, in brick and cement, with pipes and heating radiators extending through the hotel is not a machine within the meaning of Maryland Code, Art. 63, Section 2, providing that every machine erected, constructed or repaired shall be subject to a mechanics' lien in the same way as buildings; and the apparatus was held not subject to a lien for repairs thereon under this section. Stebbins v. Culbreth, 88 Md. 656.

"This structure is a part of the building, and is in the nature of a permanent fixture and necessary for the comfortable, convenient and customary use of the building as a hotel."

A lien may be had under the Indiana Mechanics' Lien Statute for materials, in this case radiators, piping, heaters, fittings and supplies, furnished for the installation of a heating plant in a hotel as a part of the building. Siegmund v. Kellogg-Mackay-Cameron Co. 38 Ind. App. 95, 77 N. E. 1096.

A lien for steam heating apparatus installed in a hotel consisting of boilers, steam pipes throughout the building, connecting the boiler with 23 radiators, with all necessary fittings, horizontal pipes being suspended in welded coil chain, was sustained under the Pennsylvania statute of 1836 subjecting buildings to a lien for debts contracted, work done or material furnished for or about their erection. Dimmick v. Cooke & Co. 115 Pa. St. 572. The court said: "When a man constructs a building for a hotel, everything of a permanent character which will pass as a part of the freehold, and which is reasonably necessary to equip it for the purpose for

which it is erected, is a part of such building, and therefore comes within the Act of 1836."

In an action to enforce a mechanic's lien for furnishing a warm-air furnace, pipes, registers, etc., for a dwelling, it was held the question of intention to annex was a criterion and mere physical annexation was not a test.

Under the Missouri Mechanics' lien statute the contractor was held entitled to a lien for installing the furnace even though the contract provided it should be put in so that it could be "removed without disturbing plastering or defacing ceiling." Cooke v. McNeill, 49 Mo. App. 81, citing Dimmick v. Cooke, 115 Pa. St. 573, and Stockwell v. Campbell, 39 Com. 362, decided under similar lien statutes.

To the same effect is Goodwin v. Elleardsville Hall Assn. 5 Mo. App. 289, 294, which distinguished between such a furnace and a portable furnace which could be removed without disturbing ceiling, walls or floor, held in Baldwin v. Merrick, 1 Mo. App. 281, not to be a fixture within the mechanics' lien law. The court in the Goodwin case said that "the mere fact that the furnaces might be removed, were portable, and could be taken out without substantial injury to the building, would not be conclusive of a right to a lien."

A similar decision was made under the New York mechanics' lien statute in regard to a warm-air system of heating in Union Stove Works v. Klingman, 20 App. Div. 449, affirmed 164 N. Y. 589.

In New Jersey, a lien was allowed for a heater and range put in by the owner with the intention that they should be fixtures. Erdman v. Moore, 58 N. J. L. 445, 33 Atl. 958. This case was followed in Porch v. Agnew Co., 70 N. J. Eq. 328, 61 Atl. 721, affirmed 71 N. J. Eq. 305, where the range was connected with steam pipes running through a hotel.

In Turner v. Wentworth, 119 Mass. 459, portable furnaces, pipes and registers were held a fixture if sold to go into the building, but not be a fixture if sold as personal property.

In American Radiator Co. v. Pendleton, 62 Wash. 56, 112 Pac. 1117, a boiler, radiators and other equipment, part of a water heating plant and connected with a distributing system of pipes built into the house, were held to be fixtures and subject to a mechanics' lien, although they could be separated and removed without damage to the building. It was conceded that the distributing pipes became part of the realty; and there was no evidence of any intention on the part of the owners that the boiler, radiators and other appliances should not become permanent fixtures. The contract was to install the entire heating plant as a complete job.

In U. S. Nat. Bank v. Bonacum, 33 Neb. 820, 51 N. W. 233, it was held that a mechanic's lien will attach to a furnace when placed in a church, or other building. And a mechanic's lien was allowed for the installation of a heating plant in a three-story and basement frame house. Wentz v. Frickel, Neb. 196, N. W. 639.

In Michael v. Reeves, 14 Colo. App. 460, it was held that a contractor claiming a mechanic's lien for a furnace placed in a dwelling house must show that the furnace was so attached to the realty as to lose its character as movable personal property.

HEATING PLANT PLACED ON MORTGAGED PREMISES

A steam heating plant and hot water generating plant was placed on mortgaged premises under a conditional sales contract between the vendor and the mortgagor which was duly filed in the office of the registrar of the city of New York. It was held the plants retained their character as personalty and the mortgagee had no lien on them. Condit v. Goodwin, 44 Misc. (N. Y.) 312, 89 N. Y. Supp. 827, affirmed 107 App. Div. 616.

In a later case it was held that although the contractor installing a heating plant in a building and the original owner of the building could by such conditional contract preserve the character of the heating plant as personalty, the agreement was not binding on a bona fide purchaser who took the plant as part of the realty without notice.

The filing of a mechanic's lien against the original owner's interest was inconsistent with the contractor's claim of title to the heating plant, and was an election of remedies. Kirk v. Crystal, 118 App. Div. 32, 103 N. Y. Supp. 17, affirmed 193 N. Y. 622.

The Connecticut Supreme Court held that a portable warm-air furnace, placed by the owner in the cellar of a dwelling house to heat the house, and set in a pit prepared for it in the bottom of the cellar, where it was held in place simply by its own weight, was a part of the realty, and the contractor who placed them in the house was entitled to a lien upon the entire house for their value and the value of the work done in installing them, although they could have been removed and reset without difficulty and without appreciable injury to the furnaces themselves, or to the house. The smoke-pipe connecting the furnace with the chimney was also held to be a part of the realty. Stockwell v. Campbell, 39 Conn. 362.

In this case the court said that the annexation need not be such as to require any actual description for its removal. The article may be attached to the building by mere adjustment of construction and putting in place; it may be held in the place prepared to receive it by its mere size and weight.

The Illinois Mechanic's Lien Act makes a distinction between material delivered for the purpose of being used in the construction of a building and that used merely as a means in the process of construction, except where specifically provided by the act, and the Illinois Supreme Court, in Hoier v. Kaplan, 313 Ill. 448, 145 N. E. 243, denied a lien for the installation of radiators temporarily in winter, claimed as "Labor furnished in maintaining heat," although this was necessary to prevent the concrete floors cracking and the plaster falling from the walls, and the men refused to work unless it was furnished, there being no provision for such a lien in the statute.

WAIVER OF LIEN

A heating contractor may waive his right to a lien by an express agreement to do so in his contract with the owner. So, where a printed contract to provide the work and material necessary for the installation of a steam heating plant was executed in duplicate, at or after the interlineation in red ink in both copies of the words "free from mechanics' liens," it was held that the contractor expressly excluded himself from any and all right to a mechanic's lien. William Sullivan Co. v. Crafts, 227 Ill. App. 383.

A contrary decision in Advance Terra Cotta v. Moran, 207 Ill. App. 17, where it was held that an agreement by a contractor to complete the work "free and clear of any liens or encumbrances" was not a waiver of his own right to a lien, but was limited to the liens of his subcontractors, was held to be based apparently upon a misapprehension of the language used in Concord Apartment House Co. v. O'Brien, 228 Ill. 476. In that case the contract, in a clause referring to subcontractors' liens, provided that the contractor should furnish, whenever requested, "a release from any liens or right of lien." It was held that the parties had in mind subordinate contracts only. No words were used constituting an express waiver of the contractor's lien.

See also Dupuis v. Snook, 186 Ill. App. 330, where agreements to deliver the work "free from liens" were held to constitute a waiver by the original contractor of his right to a lien.

In order to constitute a waiver of a lien given by statute, the contract must contain an express covenant against liens, or the language of the contract must be such that a covenant against liens can be clearly implied therefrom. The language upon this subject should not be ambiguous or uncertain, but it should be so clear that a mechanic or material man may understand it without consulting a lawyer as to its legal effect. Carson Payson Co. v. Cleveland, C. C. & St. L. Ry. Co., 57 Ind. App. 357. Concord Apartment House Co. v. O'Brien, 128 Ill. App. 437, affirmed 228 Ill. 476.

A contractor, subcontractor, or person furnishing labor or material for a building can waive his right to a lien by agreeing that he will not claim a lien, or by assenting to a provision in a contract stating that no liens shall be claimed or filed against the building. But a person furnishing labor or material that goes into a building cannot be deprived of his right to file a lien, excepting by his contract, or by acts on his part constituting an estoppel. Zanello & Son v. Portland Central Heating Co., 70 Ar. 69.

How Would You Do It?

IN introducing the department "How Would You Do It?" three problems are presented of which solutions to only the first two are given in this issue. The answer to the third will appear next month.

FEW heating and ventilating installations are made without encountering some problem in design, installation or operation. To aid the reader in meeting such situations, commencing with this issue, THE HEATING AND VENTILATING MAGAZINE will present one or more problems every month, the solution of which will be given in the following issue.

Work out each problem the way you would solve it and compare your solution with that published. All problems will not be too difficult for the average heating and ventilating man to solve, but new ideas may be suggested by the published replies.

Question 1

How much boiler capacity should be allowed for an air heater in which 20,000 *cu. ft. of air per minute is heated from a minimum of zero up to* 70° *F. as a maximum; in other words, with a temperature rise of* 70° *F.?*

And the answer is:

20,000 cu. ft. of air per minute is 20,000 x 60 or 1,200,000 cu. ft. per hour. As 1 B.T.U. will raise 50 cu. ft. of air 1° F., it would take 1,200,000/50 or 24,000 B.T.U. to raise this quantity of air 1° F., and to raise the same quantity 70° F. will take

24,000 B.T.U. x 70 or 1,680,000 B.T.U.

If the boiler capacity is in square feet of direct radiation as heating boilers usually are rated, the boiler capacity is based on 240 B.T.U. to 1 sq. ft. of radiation, so the number of square feet of rating would be

1,680,000/240 or 7,000 sq. ft.

If the boiler is rated in H.P. then 100 sq. ft. of radiation is usually taken as equal to 1 H.P., so

7,000/100 equals 70 H.P. (boiler).

Question 2

A man has 2000 *sq. ft. of common direct radiation located* 500 *ft. away from a boiler supplying an existing steam heating installation. The pipe between the boiler and the radiation will be run overhead and well insulated but will be exposed at times to zero temperatures. The boiler is sufficient to carry the added load and a new vacuum pump is to be installed for the returns. He wants to know what size of pipe will be necessary on the supply for a* 1 *lb. drop in pressure, assuming* 2 *lbs. gauge as the initial pressure, and what size of return line should be used.*

The solution for the above is worked out by determining the amount of steam which would be required for the radiators and adding to this amount the quantity of steam condensed in the pipe line in order to get the total quantity of steam required to be handled by the line. Then, by looking up in the pressure drop tables, the proper size of pipe may be obtained.

For instance, the pipe is to be considered as "well insulated" which may be taken to mean that the insulation will have an efficiency of around 75% since ordinary covering ranges around 60% to 65%. The radiation from bare iron pipe may be considered as approximating 3 B.T.U. per degree difference between the temperatures inside and outside of the pipe.

Now, steam at 2 lbs. gauge pressure has a temperature of approximately 220° F. and the difference between 220° F. and zero, of course, is just 220°. So, at an efficiency of 3 B.T.U. per degree the transmission of the pipe in zero weather would be

3 B.T.U. × 220 or 660 B.T.U.

and with covering on the pipe of 75% efficiency (that is retaining in the pipe 75% of the heat which would otherwise radiate from the bare pipe) the transmission of the pipe, per square foot of surface, would be

660 B.T.U. × 25% or 165 B.T.U. per square foot.

But a difficulty now develops that the size of the pipe being unknown, it will be impossible to determine the number of square feet on the pipe. Here is where a little common sense should be used. Suppose the size of pipe is determined without considering the condensation in the line and then the next size larger is assumed to allow for the line loss. This size then may be used for trial.

Reference to pipe-sizing tables for 2 lbs. gauge pressure and ½ lb. drop on a 500-ft. run shows that 2,000 sq. ft. of radiation will require a 4-in. main and the next size larger is 4½-in. pipe. The square feet of surface on a 4½-in. pipe is 1.31 per lineal foot, while for a 4-in. pipe it is 1.17. Consequently with a 4½-in. pipe the surface for a 500-ft. run would be

1.31 sq. ft. × 500 or 655 sq. ft.

whereas with 4-in. pipe the total surface would be

1.17 sq. ft. × 500 or 585 sq. ft.

The reason the half-pound drop table was used in the above is because all tables of drop are based on *straight pipe with no allowance for fittings* and the actual drop which, of course, includes all fittings, valves, and other causes of pressure loss, has been found to approximate twice the theoretical drop shown by tables for straight pipe. As a result, if an actual drop of 1 lb. including all causes of fall in pressure is desired, the theoretical drop used must be only about half as much because it will be doubled in the actual installation. Thus where actually 1 lb. drop is desired, the half-a-pound table should be used.

Now the radiation load was 2,000 sq. ft. and the area of the pipe is 655 sq. ft. if 4½-in. pipe is used, and 585 sq. ft., if 4-in. pipe is used. The next thing to do is compute the radiation from the pipe which may be done by multiplying the area by the efficiency after the pipe is covered. Thus, for 4½-in. pipe the loss will be (with 75% efficiency covering)... 655 sq. ft. × 165 B.T.U. or 108,075 B.T.U., and with 4-in. pipe,

585 sq. ft. × 165 B.T U. or 96,525 B.T.U.

To change this into square feet of radiation, or equivalent direct radiation as it is called, it is only necessary to divide the B.T.U. amounts by 240, which is considered as the average efficiency figure for ordinary cast iron radiation. Then the E.D.R. for 4½-in. pipe is,

108,075 B.T.U./240 or 450 sq. ft.

while for 4-in. pipe it is

96,525 B.T.U./240 or 402 sq. ft.

From this it will be seen that the total load including the covered main will be 2,000 sq. ft. plus 450 sq. ft., or 2,450 sq. ft. for 4½-in., and 2,000 sq. ft. plus 402 sq. ft., or 2,402 sq. ft. for the 4-in. pipe. Referring again to the pipe-sizing table for half-pound drop on 500 ft. run it is found that a 4½-in. pipe will carry 3240 sq. ft. so that this is amply large; checking back on the 4-in. pipe it is found that this pipe will carry 2420 sq. ft. under the same conditions. As the total load using 4-in. pipe is 2,402 sq. ft., it will be seen that the 4-in. pipe will just carry the load if all the assumptions made are absolutely correct.

To allow a small factor of safety to take care of any contingencies the 4½-in. size should be used.

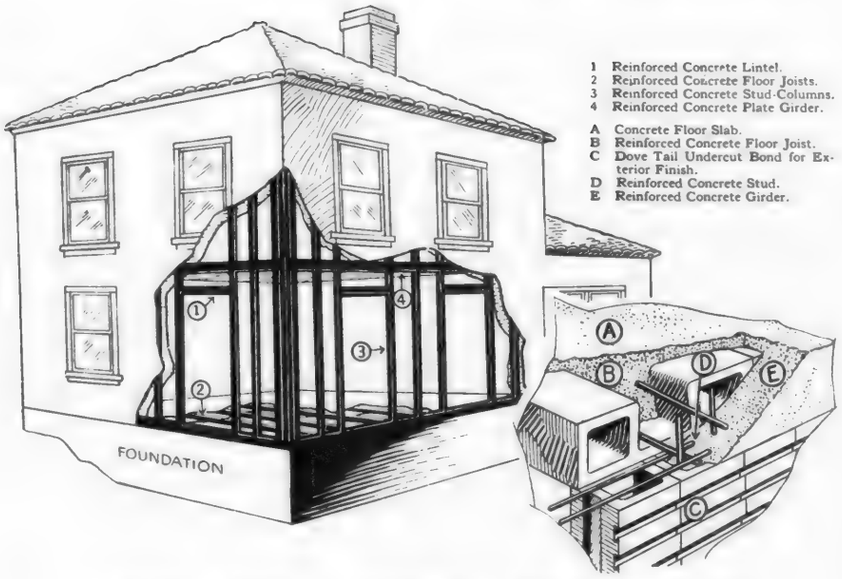
The question for next month is one dealing with an air problem such as often is met with in recirculation work. Here it is:

Question 3

If a fan handling 10,000 *cu. ft. of air per minute is arranged with the dampers so as to take three-quarters of its suction air by means of recirculation and one-quarter of its air from the outside, what will be the temperature of the air delivered by the fan when the outside air is* 60° *F. and* 50% *relative humidity and the recirculation air is* 70° *F. and* 40% *relative humidity? Also what will be the relative humidity of the air as delivered by the fan?*

Cellular Concrete and Its Heat-Insulating Properties

By T. W Reynolds

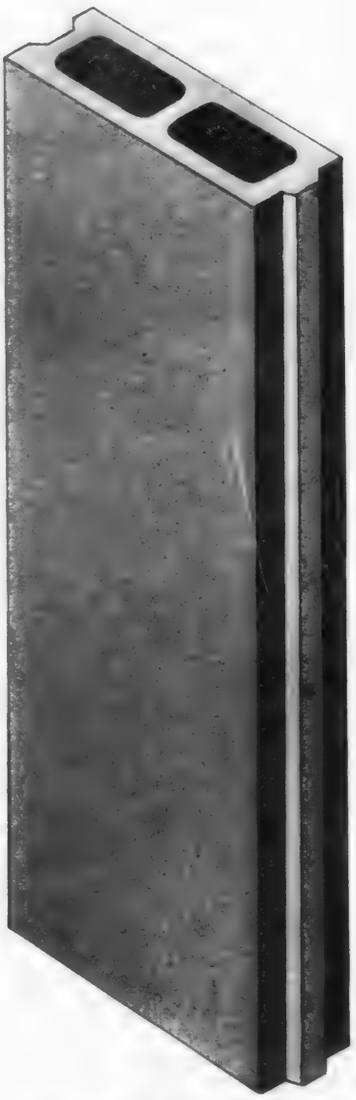

1 Reinforced Concrete Lintel.
2 Reinforced Concrete Floor Joists.
3 Reinforced Concrete Stud-Columns.
4 Reinforced Concrete Plate Girder.
A Concrete Floor Slab.
B Reinforced Concrete Floor Joist.
C Dove Tail Undercut Bond for Exterior Finish.
D Reinforced Concrete Stud.
E Reinforced Concrete Girder.
FOUNDATION

Building a House of Concrete on a Reinforced Steel Frame

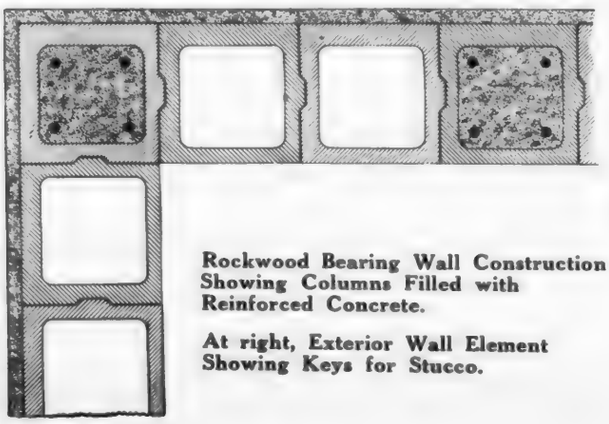
AMONG the vastly-increasing flood of new building materials are various forms of light-weight concrete and gypsum. These materials, it seems fairly conservative to say, are destined to play an important part in all building construction, the weight of ordinary concrete, for example, being such as to check its popularity from a cost-cutting standpoint.

Quite recently various methods have been devised for making light-weight materials in cellular or honeycomb form. One material, known as Aerocrete, uses a combination of Portland cement, lime and powdered aluminum which generates a gas (hydrogen) and at the same time accelerates the set of the concrete*. A somewhat similar proposition** involves the use of soap bubbles, whereas a third method (Porete) uses wax pellets as fine aggregates in place of sand. In this process the concrete is allowed to set, after which it is subjected to high temperature in order to evaporate and withdraw the wax, thus leaving the concrete full of small air-spaces, so as substantially to reduce its weight, as well as to increase its heat and sound-insulating properties.

Though heating engineers are interested primarily in the heat-insulating properties of the materials, nevertheless it is important that they become familiar with their other qualities. The architect and builder necessarily must find them adaptable and in all respects entirely suitable to the structure, hence a material may receive scant consideration if suggested solely on the basis of better heat insulation.

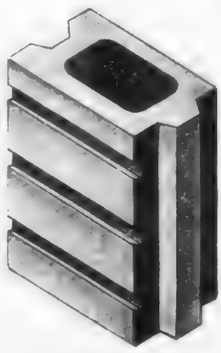


Rockwood Wall Section with Rectangular Holes and Tongue and Groove



Rockwood Bearing Wall Construction Showing Columns Filled with Reinforced Concrete.

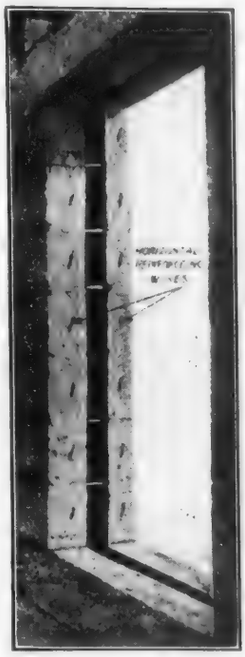
At right, Exterior Wall Element Showing Keys for Stucco.

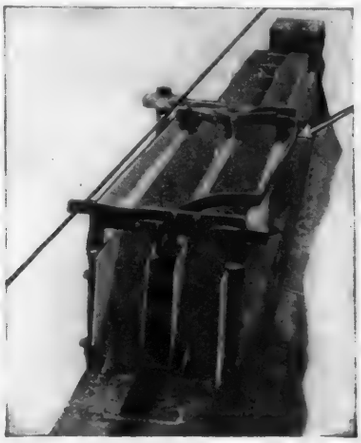


On account of its soundproof qualities, light-weight concrete has been found especially adaptable to hospitals, hotels and music studios; while the fact that

*Not a true concrete as generally understood, rather a neat cement mortar consisting of cement and fine aggregate.

**As exploited by Christiani & Nielsen, Copenhagen. Comparatively new in the United States, though used extensively in the Scandinavian countries for several years in the erection of all classes of buildings.



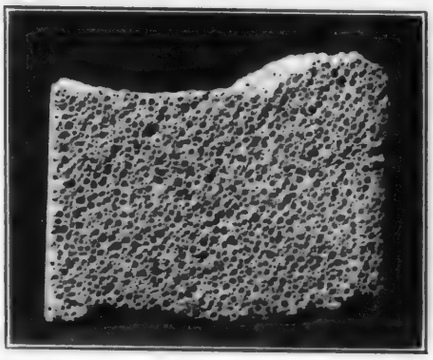


These Three Views Show Van Guilder Forms and Method of Their Application in Wall Building

it eliminates condensation trouble, gives it a particularly desirable quality for roofing.

Unlike common brick, each cell of light-weight concrete constitutes a closed pore and, consequently, there is no capillary or moisture-absorbing action. Its adhesiveness makes an exceedingly strong bond between it and any reinforcement and also makes possible the use of a much thinner surface coating. Lath for the purpose of taking plaster is not required. Furthermore, it is possible in the process of molding to give practically any desired outside surface to the walls or blocks, or, if required, it can be easily sawed, grooved, spiked and screwed.

The lightness of cellular concrete makes it possible to complete walls in horizontal form for subsequent raising into position. Slabs of large size can be precast and easily handled, thus effecting quite a saving of labor in erection. Obviously, transportation costs are considerably lower. Again, in all-steel building construction a substantial saving in steel and foundations is possible. Its lightness, furthermore, makes it valuable for additions on tops of existing buildings.

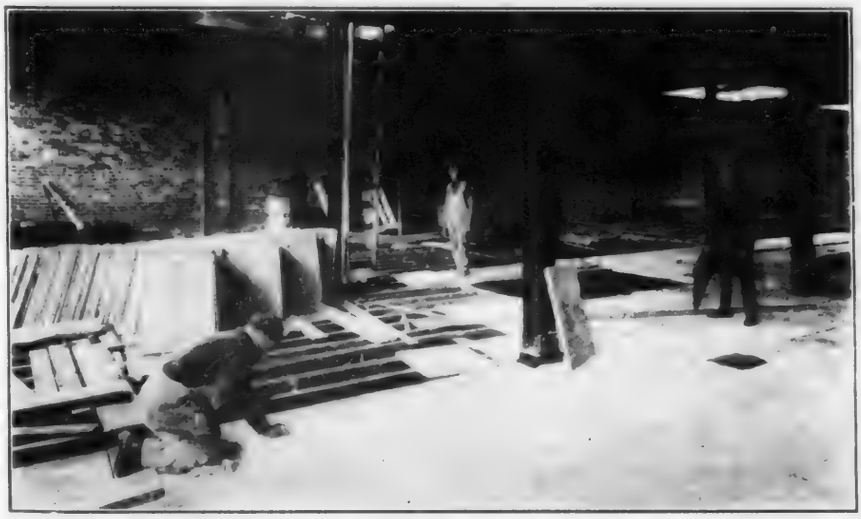


Aerocrete—a Poured Insulation Material

Light-weight concrete is of considerable importance wherever it is necessary to use special insulating materials possessing mechanical strength. It is especially desirable where maintenance of fixed temperatures is imperative, as in cold-storage plants, ice houses and drying kilns. Furthermore, its heat-insulation properties render furring for this purpose unnecessary.

The quality of cellular concrete can be varied within fairly wide limits by varying the ratio of aggregate to cement and by varying the porosity. The amount and quality of the aggregate used also affect the insulating properties to some extent. It has been found that small voids of considerable number produce greater insulation then larger voids in less number.

How Porete Looks



Laying a Porete Floor

TRIANGLE NEWS, for August, published by Richardson & Boynton Co., New York, is displayed in a bright blue cover with a set-in picture of a heating plant, being inspected, as the caption underneath indicates, "His inspection work was to be done afternoons and evenings. . ." This is one of a series of illustrations accompanying an article within, entitled, "Over the Top to Bigger Business," by Dick Boyd. In this article the way is pointed out for progressive heating contractors to the achievement of definite results in equalizing the sales curve, and at the same time increasing sales volume. Another plan is told in a story headed "Direct Leads to Repairs and Replacements." There also are two pages of pictures showing some of the types of buildings in which this company's boilers are installed. Size 8¾ in. x 11¾ in. Pp. 18.

Novel Electric Heating Installation at London Zoo

A NEW reptile house has just been completed at the Royal Zoological Gardens, London, in which the reptiles are kept under conditions as closely as possible approximating those of nature. The curator, Miss Proctor, who has kept snakes, lizards and frogs as pets since she was a child and who has a practically unique knowledge of living reptiles and their needs, laid down some exacting conditions for the health and comfort of her charges when she was supervising the plans of the new reptile house.

EXACTING HEATING AND LIGHTING CONDITIONS DEMANDED

Most reptiles can be kept healthy only when the water in which they bathe, the rocks on which they bask, and the walls surrounding them are kept at a temperature of 80° F., but it is necessary to vary this optimum in different cages. Good ventilation is essential, although reptiles are more tolerant of stagnant air than are birds or mammals. They demand sunlight, and when deprived of that they must have an artificial substitute. These conditions have to be met in a building designed not merely for reptiles, but where visitors can see the reptiles in safety and comparative comfort.

Experts of the General Electric Company, Ltd., undertook to meet these peculiar needs as the problem was one of technical interest, and for months the commercial branches of the company and the very enthusiastic research department were engaged in consultation with Miss Proctor. The result is an entirely unique example of applied electrical heating and lighting science, and its success is a gratification both to the Zoological Society and the company which undertook the bold experiment.

Some idea of the complexity of the problem involved will be evident from the fact that the building, although only of one floor, 180 ft. by 80 ft., contains 20 miles of electric cable, and that areas a few feet square have anywhere from 28 to 200 electrical connections.

NOVEL METHOD OF COMBATING CONDENSATION

To save waste of current and to provide for the comfort of the visitors, the heating elements are confined to cages and dens, in most cases separated from the public passages by glass windows. It was plain that condensation of the moisture in the dens would tend to obscure the glass by a deposit of mist; this successfully has been overcome by focusing rays of dark heat from special radiators directly on the glass. Other sets of radiators are placed to throw pools of brilliant artificial light, rich in ultra-violet rays, directly on the rocks and ledges on which the reptiles may bask in the full view of the public. A third set supplies ordinary lighting to be used on dull days or after dark. These various sources of light and heat have to be so placed that they are invisible to spectators in the public corridors, and they must be protected from the dangerous inquisitiveness of the reptiles themselves. Full advantage, moreover, has been taken of what sunlight the London sky may give, and the windows to the outside, glazed with Vitaglass, also have to be concealed, where possible, from the public gaze.

All these variations, although their immediate purpose has nothing to do with the temperatures required by the reptiles, in fact do affect the general temperatures of the cages to a high and rapidly-varying extent. On a cloudless summer day the amount of direct heat from the sun is almost sufficient to provide the necessary temperatures, but to an extent varying from hour to hour, and from cage to cage, as the sun changes its position. So, also, on a dark winter day, the full supply of artificial lighting rapidly raises the temperature. The fluctuations might be dangerously great if the heating system were one of the usual hot water or steam types, with the limited flexibility possible.

THERMOSTATIC CONTROL PREVENTS CURRENT WASTE

The electric current supplied to the heating elements in each cage is controlled by automatic thermostats of a special design. Each of these is set so that the current automatically is shut off when the temperature reaches 83° F. and automatically restored when it falls to 77° F., but the setting can be altered when required. Thus, if heat is coming from the sun or from the artificial lights, less current will be supplied to the heaters.

To provide against the possibility of temperature rise or fall to a dangerous point from some failure in the thermostats or in the heating elements themselves, an independent tell-tale device has been installed, linking each cage to an indicator board in the head-keeper's room. If the temperature in any compartment rises to 85° F., a bell rings and a small red light shows against the number on the board representing the defective cage; if the temperature falls to 75° F. the bell also rings and a green light shows.

DETAILS OF ELECTRIC HEATERS

The heating elements themselves are of a particularly sturdy type, never rising to a glow even when at maximum load, consequently they have a long life. They are flat in shape when they are imbedded in the concrete floors of the cages or in the shelves of the rock-work, and are placed so that, although they slowly diffuse warmth through the whole concrete area, they give a maximum temperature on spots where the reptiles may be tempted to lay in full public sight. Where embedded in the walls and in the sides of the ponds and the baths, the heaters are tubular in shape.

Each heater fits in a metal box, the cover of which is so placed that it can be opened and the heater examined, withdrawn or replaced from "behind the scenes" without disturbing the reptiles. One of the most difficult phases of the entire problem was the combined work of the curator and the engineers in choosing locations for the heaters where they would suit the animals and the scenery and still be accessible.

The electric supply is derived from the London mains on a three-phase system of 415 volts.

New Freight Rates Recommended on Bituminous Coal

Examiners of the Interstate Commerce Commission, in a recent report, recommend the permanent establishment of joint freight rates and through routes on prepared sizes of bituminous coal from mines in Virginia, West Virginia and eastern Kentucky, to destinations in New England and the Middle Atlantic States.

The study of this problem originally was instituted by the commission for the purpose of investigating the rates, charges, regulations, and practices governing the transportation of anthracite coal, but later it was broadened to include bituminous coal. If the report now before the commission is adopted and put into effect, most of the temporary rates will become permanent.

Glancing Backward

High Lights in the Evolution of Leaders in the Heating and Ventilating Industry

I. *Minneapolis Heat Regulator Company*

RETROSPECT is always interesting — frequently valuable. Turning the pages backward makes it possible to establish rates of development; to more completely picture the events that were turning-points in the steady progress that has been made by present-day leaders in the heating and ventilating industry.

From Minnreg, the frequently issued little house organ of the Minneapolis Heat Regulator Company, and from additional data furnished, this human-interest story was compiled.

THE Minneapolis heat regulator was the invention, in its thermostatic features, of A. M. Butz, in 1883-4. The original company was incorporated in 1885, and passed through various stages natural to the development of an entirely new art.

Many obstacles had to be met; for instance, in those days no lift dampers were furnished on boilers or furnaces, as the thermostat, though a great invention, was not perfected. A satisfactory motive power had not been developed.

A great deal of money and time was spent in bringing about the necessary changes. The boiler and furnace manufacturers gradually changed their equipment; the coiled thermostat element replaced the original straight element; the Guion motor, embodying the patented forked switch feature, was put on the market, at Elmira, N. Y., and the Minneapolis interests purchased the Guion Company and succeeded to all of its rights and business in the year 1889.

From that time on, the growth of the business was marked, year by year. The president of the company, W. R. Sweatt, has been connected with it as a director, since 1891, and in entire charge of the management of the business since September, 1892, uninterruptedly. In 1891 there were only four or five people employed; now the employees at the home office and factory number over 500. At the branch offices and major distributors' offices, approximately 200, and in dealer and smaller distributor organizations over 2,000 men are actively engaged in selling Minneapolis equipment.

W. R. Sweatt
One of the real pioneers in the industry.

The thermostatic device originally was known as the electric thermostat and the company as the Consolidated Temperature Controlling Company, later the Electric Thermostat Company—reorganized as the Electric Heat Regulator Company in 1893—and in 1912 the name was changed to the Minneapolis Heat Regulator Company.

During the time of the company's existence, all of its energies have been confined absolutely to the manufacture of heat regulating and thermostatic devices exclusively.

Recently, in searching the archives there was found an advertisement which appeared in the *Century* Magazine, for December, 1887. This was published by the Guion Automatic Heat Regulating Co., of Elmira, N. Y., which was, within a year, bought out by the Minneapolis interests. Even in these early days, the emphasis falls on "Health, Comfort, Economy."

In the November and December issues of *Century*, 1887, appears the first advertisement of the Consolidated Temperature Controlling Company, later the Electric Heat Regulator Company, and now the Minneapolis Heat Regulator. There is a warning, "do not buy, sell or use any infringing apparatus." Even in those early days business was not free from such troubles. In fact, at the time this advertisement appeared there was a merry war going on, as the basic patents on the thermostat were held by the Consolidated Company.

Advertising and its preparation were in their infancy at this time; copy was repeated month after month, in fact the same copy appeared from January, 1889, to March, 1891.

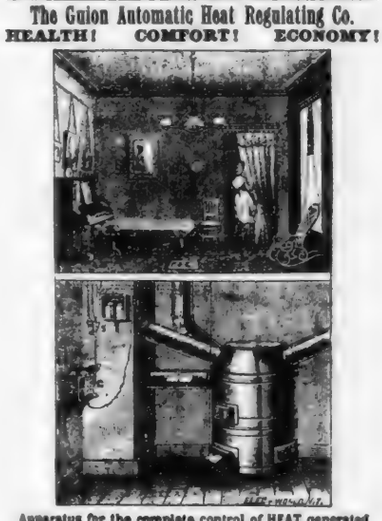
There is no record of the next two years' advertising. In the December, 1894, *Harpers*, an advertisement appears under the name of "Electric Heat Regulator Company, Wm. R. Sweatt, secretary."

In 1895 the thermostat was featured for the first time; from that date on, the thermostat has held a prominent place in advertising layouts.

When the first thermostat or heat regulator was put on the market by the founders of the present company it was a brand new thing. It was just as new as wireless—just as new as the telephone. It was a basic invention. There were many handicaps to overcome—heating plants were not designed so that regulators could be attached and

It Runs Your Heat
Just hot enough—just cold enough—just coal enough—just right. Drop us a postal for free information.
WM. R. SWEATT, Sec'y.
ELECTRIC HEAT REGULATOR CO.,
26th St. and J Ave., S., Minneapolis, Minn.

A Thermostat Advertisement of a Past Century


The Guion Automatic Heat Regulating Co.
HEALTH! COMFORT! ECONOMY!
Apparatus for the complete control of HEAT generated by FURNACE, STEAM, or NATURAL GAS.
Prices on application. Agents wanted for exclusive territory.
Write for circular, mentioning THE CENTURY.
Office, 150 Exchange Place, Elmira, N. Y.

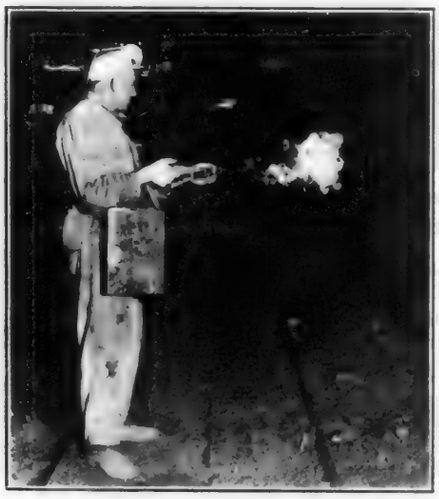
Automatic Heat Regulation as Advertised in 1889

even today there can be found some of these old-time heating plants that do not have a lift draft or lift damper. The redesigning of practically every type of heating equipment largely was due to the introduction of automatic temperature control. Therefore, it was a tremendous problem that confronted this infant industry. People had to be told there was such a thing as a device that would give them automatic temperature control and after being told they had to be convinced that such a truly magical device was really practical. Even in the early 90's there were comparatively few educated people who knew there was such a thing as a heat regulator—to-day it is doubtful if there can be found a single educated person who does not vaguely know there is such a device as a Minneapolis heat regulator.

Air Currents Made Visible By Bureau of Mines Instrument

Determining the flow of air, the velocity of air currents, and the rate of mixing gases in mines and tunnels, has become possible through an instrument devised by engineers of the U. S. Bureau of Mines. This instrument generates sulphuric trioxide which, ejected in a dense white cloud, is easily photographed.

The apparatus consists of a glass tube, containing fuming sulphuric acid on granular pumice stone, attached to

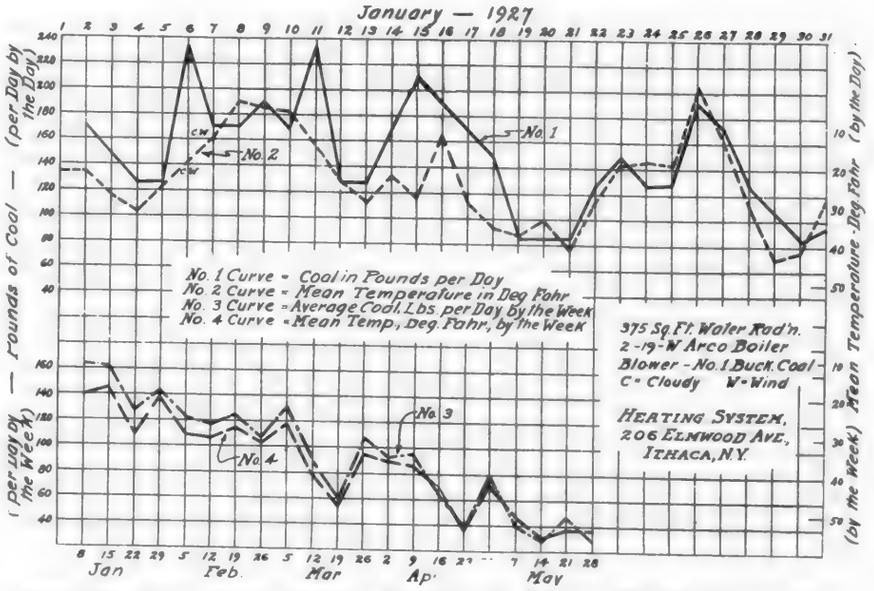


Detecting Air Flow With New Bureau of Mines Instrument

a rubber syringe bulb. By squeezing the bulb, the stream of white smoke is evolved. Until ready for use the tubes must be kept sealed to prevent absorption of moisture from the air.

A tube provides sufficient chemical for the day's needs. To use the tube, it is broken open by a file scratch on both tips.

This instrument easily may find many applications in the general ventilating field.


January — 1927
No. 1 Curve = Coal in Pounds per Day
No. 2 Curve = Mean Temperature in Deg Fahr
No. 3 Curve = Average Coal, Lbs. per Day by the Week
No. 4 Curve = Mean Temp., Deg. Fahr., by the Week
375 Sq. Ft. Water Rad'n.
2-19-W Arco Boiler
Blower - No. 1 Buck. Coal
C = Cloudy W = Wind
HEATING SYSTEM, 206 ELMWOOD AVE., ITHACA, N.Y.
Jan
Feb.
Mar
Ap.
May

Daily Coal Consumption During January and Average Weekly Consumption, January to May

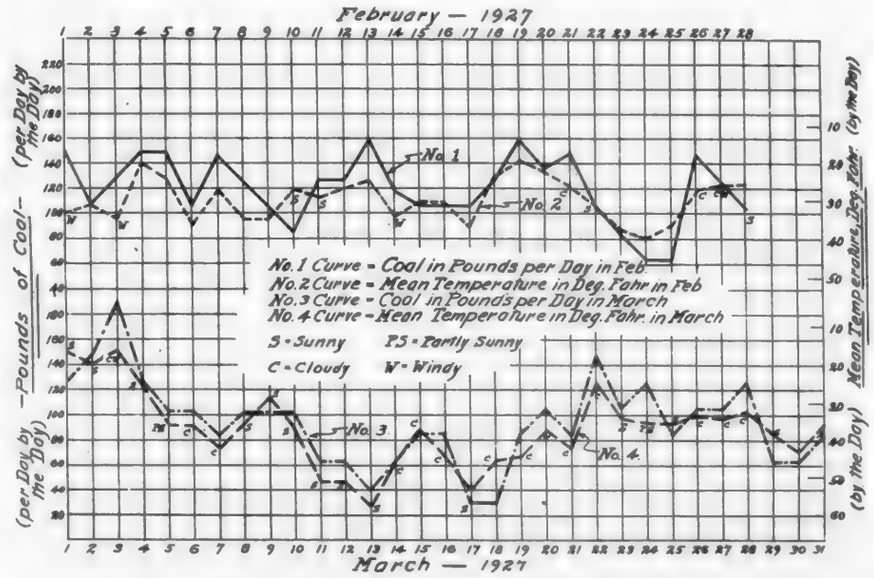
Heating Ten-Room House With No. 1 Buckwheat Coal

PERFORMANCE data for a heating plant for a ten-room house, in which the fuel used was No. 1 Buckwheat coal, are given in the accompanying curves and constitute convincing evidence of the economies possible with the equipment as installed.

The house is 30 ft. x 28 ft. outside, two stories, 8-ft. ceilings (with cellar and attic not heated). The construction is frame, interior finished with plasterboard, plastered. The outside is stucco. The roof is slate. There are 22 double hung windows, five of which are fitted with storm sash. The windows are very tight, allowing little leakage.

The heating system consists of 375 sq. ft. of 3-col. 38-in. water radiation supplied by an American Radiator Company, 2-19-W water boiler having 1.76 sq. ft. of grate surface. A 30-gal. hot water tank located in the kitchen is heated by a 1-in. loop in the firebox. Outside of the hot water tank there is no other radiation in the butler's pantry and kitchen, which are located directly above the furnace. The tank with the warm floor directly above the furnace room keeps these rooms quite comfortable.

A No. 2 Buffalo Baby Conoidal fan at 1750 R.P.M. furnished forced draft. The fan and a check draft are under the control of a thermostat located in the living room. The temperature throughout the heated part of the house is quite uniform and for the greater part of 24 hrs. only varies 1° or 2° F.


February — 1927
No. 1 Curve = Coal in Pounds per Day in Feb.
No. 2 Curve = Mean Temperature in Deg. Fahr in Feb
No. 3 Curve = Coal in Pounds per Day in March
No. 4 Curve = Mean Temperature in Deg. Fahr. in March
S = Sunny PS = Partly Sunny
C = Cloudy W = Windy
March — 1927

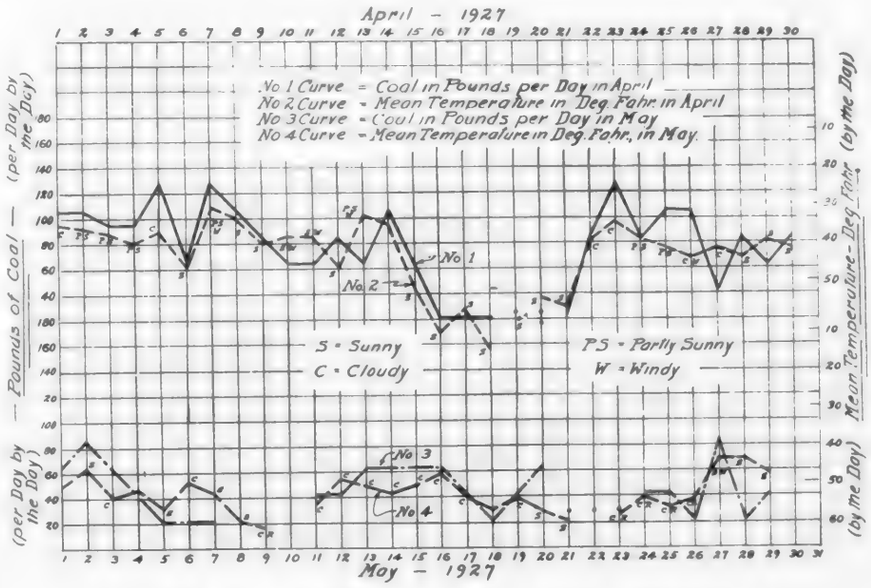
Record of Coal Consumption During February and March

Temperatures for about 7 hours at night are carried at 60° F.

The performance curves show the pounds of cool and the mean outside corresponding temperature per day from January 2 to May 31, 1927. On the lower part of the January sheet are plotted the average per day for the weekly periods.

The coal was weighed or measured in a bucket which, when filled and struck off level, held 21¼ lbs. of coal.

Note that up to January 19 the relation between coal and temperature is somewhat erratic as compared to later operation. Up to this date the stack damper and gate in the fan discharge were left wide open. The fan was usually switched on for a time after coaling and the furnace then put on natural draft. On January 6 and 11 the fan was left on the circuit so that the thermostat could cut it in or out during the entire 24 hrs., and at the same time the stack damper was full open. On January 19 with the aid of a draft gage the damper in the stack and the gate in the fan discharge were adjusted so that with fan running there was 3/100 in. suction above the fire and the gas flames only occasionally reached the intake of the smoke pipe. From this time on the thermostat controlled the fire by operating the check draft and fan "on or off."


April – 1927
May – 1927
No 1 Curve = Coal in Pounds per Day in April
No 2 Curve = Mean Temperature in Deg. Fahr. in April
No 3 Curve = Coal in Pounds per Day in May
No 4 Curve = Mean Temperature in Deg. Fahr. in May
S = Sunny
C = Cloudy
PS = Partly Sunny
W = Windy
No 1
No 2
No 3
No 4
Pounds of Coal — (per Day by the Day)
Mean Temperature – Deg. Fahr. (by the Day)

How Coal Consumption Drops As Spring Approaches

It is quite evident that up until January 19 considerable heat was lost by unburned gas or by gases burning after passing the heating surface. With dampers and fan draft adjusted as above, the CO_2 would range from 10% to 14% with fan running. For a time after fan was off the CO_2 ranged from 5% to 6%. After fan had been shut off for 2 hrs. CO_2 ran 4%. Under the above conditions the smoke pipe was always comparatively cool. The fan takes very little current.

Pipe Flanges and Fittings

An unusually close approach to an ideal piece of standardization work, in which the setting up of a new standard has kept pace, step by step, with a rapidly advancing industry—just enough in advance to guide the commercial development of the industry—is shown in a recent announcement by the American Engineering Standards Committee. It is in connection with the completion of the first of a series of standards for pipe flanges and fittings, representing the results of co-operative work on the part of more than a score of organized industrial groups, and extending over several years.

This particular standard, which has already come into very general industrial use, is one of a group which is being developed by a very large representative sectional committee, composed of appointees from 28 organizations interested in the subject, working under the chairmanship of Dean Collins P. Bliss, of the School of Engineering, New York University, and under the joint sponsorship of the American Society of Mechanical Engineers, Heating and Piping Contractors National Association, and the Manufacturers Standardization Society of the Valve and Fittings Industry.

With the increasing use of high-pressure superheated steam, the necessity of authoritative and nationally-recognized standard steel pipe flanges and flanged fittings became evident. At the same time it was desirable to anticipate the advent of still higher steam pressures, as it is the natural trend of modern industry to strive for more and more powerful units.

Several years ago when the sectional committee began its work, a few steam power plants were in operation at 350 and 400 lbs. pressure, and plans were being developed for one or two 600-lb. stations. Except for the two lower pressures the field was therefore entirely clear, and the sub-committee mapped out a series of standard working pressures in geometric ratio, viz., 250, 400, 600, 900 and 1350 lbs. per square inch. These pressures are meant as maximum working steam pressures at a temperature of 750° F. (gage indication). Eventually the pressures of 2000 and 3200 lbs. per square inch will be added.

The maximum permissible working pressures for hydraulic applications are correspondingly higher than those for steam applications. Thus, the maximum non-shock working hydraulic pressures at a temperature of 450° F. are 325, 500, 720, 1080 and 1625 lbs. per square inch (gage indication), whereas the maximum non-shock working hydraulic pressures at or near the ordinary range of air temperatures are 500, 750, 1000, 1500 and 2250 lbs. per square inch (gage indication).

Other standards belonging to the same group have recently been presented for final approval by the American Engineering Standards Committee. These are:

Cast-iron pipe flanges and flanged fittings for maximum pressures of 125 lbs., also for 250 lbs.

Malleable screwed fittings for maximum pressures of 150 lbs.

Cast-iron screwed fittings for maximum pressures of 125 and 250 lbs.

All have been prepared by sub-committees of the same sectional committee. Four more important standards on the same general topic of pipe flanges and fittings are in various stages of development, some of them being now near completion.

Welding Conference at University of Minnesota

Many users of welding and cutting equipment in the Minneapolis territory will attend a conference of the welding industry to be held at the University of Minnesota, October 20-22, 1927. Prof. S. C. Shipley, acting head of the Mechanical Engineering Department of the College of Engineering, is in charge of the program, which will be the first of its kind held in the Minnesota district.

Representative engineers will present various papers from the users' point of view and following each paper there will be a round-table discussion. The object of the conference is to standardize industrial practices and to develop many new applications and techniques from the varied experiences of many welding experts.

RICHARDSON BOILER LIQUID is described in a circular received from Richardson & Boynton Co., New York. This is a new boiler liquid designed permanently to close leaks in the heating system whether with steel or cast-iron boilers, and at high or low pressure. It does not impair the efficiency of water-treating compounds and will hold 200 lbs. pressure.

American Society of Heating and Ventilating Engineers

Report of Nominating Committee

The nominating committee, of which E. K. Campbell is chairman, has filed the following report: For president, A. C. Willard, Urbana, Ill.; first vice-president, Thornton Lewis, Philadelphia, Pa.; second vice-president, L. A. Harding, Buffalo; treasurer, W. E. Gillham, Kansas City, Mo. For council, three-year term, H. H. Angus, Roswell Farnham, Nate W. Downes and F. B. Rowley. For members of the Committee on Research, three-year term, Albert R. Acheson, R. V. Frost, F. B. Rowley, L. A. Harding and D. S. Boyden.

Next Annual Convention in New York

Meeting in New York, September 13, the council selected the Hotel Pennsylvania, New York, for the next annual convention to be held January 23-26, 1928. An innovation in program arrangement will be tried. Council and committee meetings will be held in the forenoon, Monday, January 23, and the first general session of the convention will be held in the afternoon of the same day. The convention formally will close at noon on Thursday, and that afternoon will be devoted to various inspections that are planned.

It is proposed to devote one entire session to a consideration of factory heating and ventilation.

H. Berkeley Hedges, York Heating and Ventilating Corp., 149 Broadway, New York, has been named as chairman of the committee on arrangements of the New York Chapter.

Bound Volume of 1926 Transactions Available

Appearing in uniform style with preceding volumes, the 1926 transactions of the A.S.H. & V.E. have been mailed to members. The frontispiece is an excellent photograph of W. H. Driscoll, whose tremendous energies were given, without stint, to the upbuilding of the society during his term as president.

The volume presents papers, discussions and reports from the thirty-second annual meeting, held in Buffalo, and from the semi-annual meeting in Lexington, Ky.

Doctor Cole Joins New York Commission on Ventilation

Dr. Rufus Cole, director, Rockefeller Hospital of the Rockefeller Institute for Medical Research, New York, has been elected to membership in the New York Commission on Ventilation, vice Dr. James Alexander Miller, resigned.

Doctor Cole brings to the commission an international repute as a scientist in the medical field and an outstanding prominence in research work. The commission is to be congratulated on securing this addition to its membership.

A. P. H. A. Meeting October 17-21

In addition to two general sessions, there will be six special sessions, four joint sessions, 22 sessions of the sections, and eight dinner and luncheon sessions at the forthcoming annual meeting of the American Public Health Association in Cincinnati, October 17-21. Headquarters will be at Hotel Gibson. While few papers of direct interest to the heating and ventilating people are on the program, there will be an important progress report of the Committee on Heating and Ventilating presented by Chairman C. M. Baker, of the State Board of Health, Madison, Wis., under the title of "Recent Developments in the Ventilation Controversy."

Thomas J. Duffield, executive secretary of the New York Commission on Ventilation, will also deliver a paper on "School Ventilation and Its Effect on the Health of the Pupil."

Exhibitors at A. G. A. Convention

Included among the exhibitors at the forthcoming convention of the American Gas Association in Chicago, October 10-14, are the following:

American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bristol Company, Waterbury, Conn.
The Cleveland Heater Co., Cleveland, O.
The Foxboro Co., Inc., Foxboro, Mass.
Hoffman Specialty Co., Waterbury, Conn.
Johns-Manville Corp., New York.
Linde Air Products Co., New York.
Mueller Co., Decatur, Ill.
Walker & Pratt Mfg. Co., Boston, Mass.
American Gas Products Corp., New York.
Armstrong Corp. & Insulation Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Bryant Heater & Mfg. Co., Cleveland, O.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Cleveland Gas Burner & Appliance Co., Cleveland, O.
Clow & Sons, Chicago, Ill.
Columbus Heating and Ventilating Co., Columbus, O.
Combustion Utilities Corp., New York.
Fisher Governor Co., Anderson, Ind.
Honeywell Heating Specialties Co., Wabash, Ind.
Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.
Minneapolis Heat Regulator Co., Minneapolis, Minn.
L. J. Mueller Furnace Co., Milwaukee, Wis.
The Scientific Heater Co., Cleveland, O.
B. F. Sturtevant Co., Boston, Mass.
Universal Smokeless Boiler Co., Ravenna, O.
Celotex Co., Chicago, Ill.

H. & P. C. N. A. Directors and Committees Meet

APPROVAL of the Code for Identification of Piping Systems, which had been prepared by a sectional committee, under the procedure of the American Engineering Standards Committee, was one of the important transactions at the fall meeting of the board of directors of the Heating and Piping Contractors National Association, held at national headquarters, New York, September 21-22. R. A. Wolff represented the association on this sectional committee.

The Code for Rating Low-Pressure Boilers was referred to the Sub-Committee on Boiler Output.

Invitations from 22 cities offering convention advantages were received. Final decision was reserved until the meeting of the board to be held December 5-6.

Coincident with the meeting of directors, the Committee on Standardization labored over computations of exposure factors, and, as the result of this work, ordered standard radiation estimating tables printed for Albany, N. Y., Baltimore, Md., and Syracuse, N. Y. The tables for Norfolk, and Richmond, Va., were reported printed.

The committee also worked on tables of pipe sizes for one and two-pipe installations. The work at the research laboratory, at Pittsburgh, was given careful consideration, and President Hart, chairman of the Technical Advisory Committee on Pipe Sizes, conferred with the committee on this subject.

Advertising of Certified Heating occupied the attention of the Committee on Certified Heating. A comprehensive local advertising campaign was approved, and questions of practice were discussed.

"Certified Heating" is the subject of an article by P. E. Fansler, associate editor of THE HEATING AND VENTILATING MAGAZINE, which appears in *Garden and Home Builder* for October. In this article Mr. Fansler reviews the development of certified heating and gives the home owner a very clear idea of the advantages to be secured by having a certified heating plant in his home. It is recognized that the certified heating movement will require presentation on an extensive scale to the general public to make it successful, and Mr. Fansler's article is regarded as an important step in this direction.

Gas Heats Office Building

Battery of Six Boilers Supplies Steam for 20,000 Sq. Ft. of Radiation in Westchester Lighting Company Building

GAS-FIRED boilers in the new office building of the Westchester Lighting Co., Mt. Vernon, N. Y., exemplify the advantages of heating with gaseous fuel, one of which is cleanliness and the absence of firemen in the boiler room.

Six Ideal boilers are set up in two banks of three each, connected to a box header, and so by-passed that either bank can be cut in or out at will. A Nash vacuum-return system is used.

Serving 20,000 sq. ft. of standing radiation in 120,000 sq. ft. of floor space, five boilers are expected to handle any load, leaving always one in reserve. The flue ducts are all copper.

Gas is supplied through a 5 ft. 6 in. Hinman drum wet-station meter. The maximum demand of the boiler is about 17,500 cu. ft. of gas per hour.

The architect is Basil S. King, of 18 East 41st St., New York. The heating plant and radiation was installed by Baker Smith Co., New York, under the supervision of Harvey B. McLean, chief engineer of construction, assisted by H. W. DeVed and Frank L. Kay, chief industrial engineer of the Westchester Lighting Company. This installation is said to be the second largest gas-heating plant in the East.

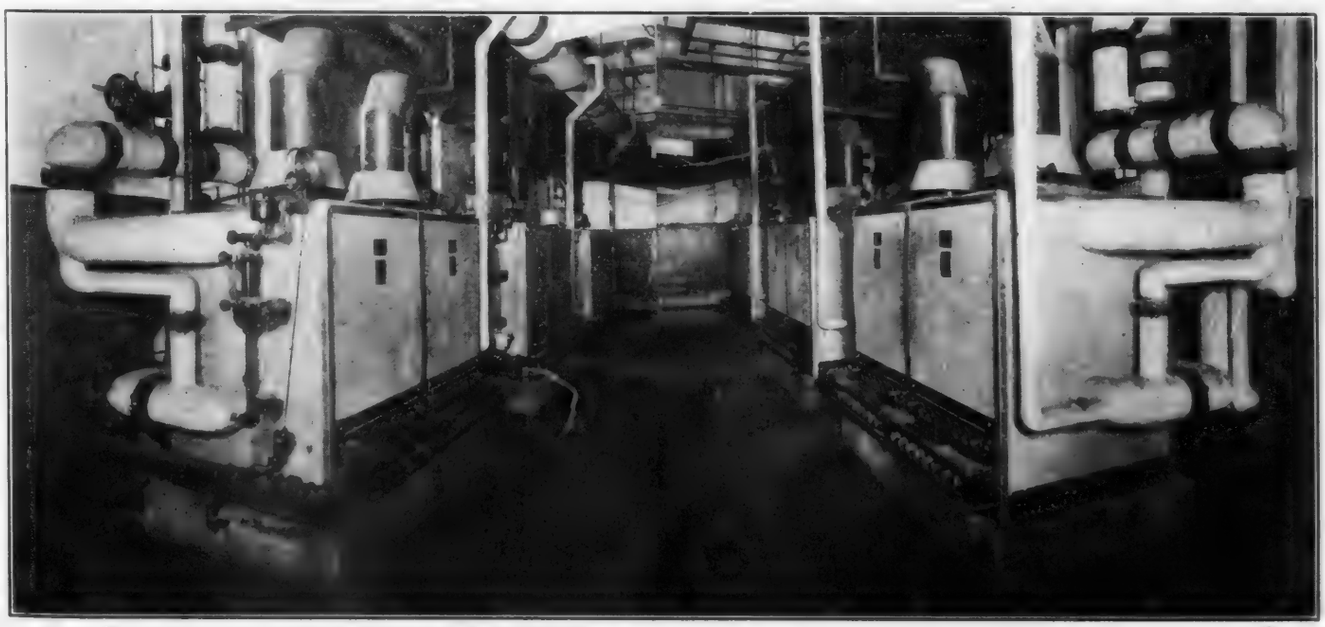
Gas Heats This Office Building

It would appear from this, and other recent articles in THE HEATING AND VENTILATING MAGAZINE, that there is a tendency, throughout the country, for gas utility companies to install gas-heating plants in their own buildings. This is but a natural result of the beginning of a nation-wide campaign for such domestic heating load as can be carried by each individual company. The question at once arises: Why is the application of gas heating to buildings owned by gas companies any example for the public to accept?—the gas company doesn't pay for the fuel, and so cost doesn't enter into the problem.

As a matter of fact, any organization with an accounting department charges off fuel cost, even if it supplies the fuel. If not so used there would have been a revenue from the sale of that fuel.

A study of the recent trend toward gas heating discloses the fact that the net cost of gas per unit is not, in a great many cases, the determining factor—rather the aggregate gain that comes from the use of this fuel over any other fuel that may be used for the same purpose.

Leaders in the "heat with gas" campaign realize that, while gas at any given price may be computed to be a luxury fuel, as compared to coal, on a B.T.U. basis, it may prove so advantageous when all of the factors are considered as to more than offset this apparent objection.

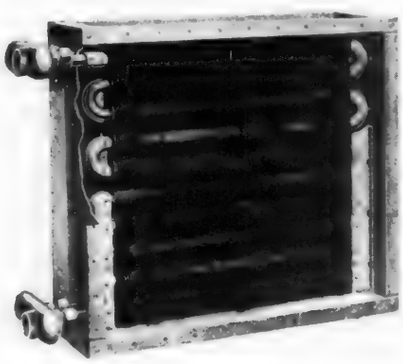


Battery of Six Boilers in Westchester Lighting Company Building

New Apparatus and Appliances

High-Pressure Aerofin—a Modern Fan-System Heating-Surface

For steam pressures from 25 to 350 lbs. gauge a compact, non-corrosive, light-weight heating-surface has been brought out by Aerofin Corp., Newark, N. J. It is composed of continuous seamless-



Aerofin High-Pressure Unit

copper tubes upon which are wound, soldered and locked the crimped extended surface which has already proven successful in the low-pressure Aerofin. The extended surface is locked around the tubes so that it is immovable, and the function of the high-temperature solder, mechanically applied, is solely to insure metallic union, so that the highest rate of heat transfer can be obtained from the tubes throughout the extended helical surface. All these parts, being made of brass and copper, offer a non-corrosive unit, which is especially advantageous in the working of traps and valves. In addition to complete technical and construction details, there are given a formula for calculating condensation, and formulae for determining the coefficient of heat transmission at various air velocities. In a booklet describing this unit are five pages of technical data giving final temperatures and condensations for different steam pressures and air velocities. There also is a graph showing performance of these units under different working conditions.

Twinfan Unit Heater Embodies Copper Radiator Element

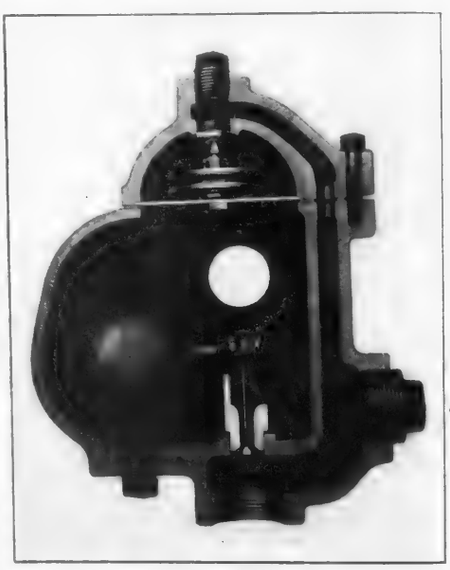
A floor-type unit heater, having two fans driven by a single motor and an extended-surface copper-tube radiator, is manufactured by Dwyer Equipment Co., Chicago. The unit is assembled on angle-iron legs, the lower portion of the casing being a duct forming the intake. The upper portion contains, in its under side, the radiator element, above which are the two fan chambers, the outlets being at the opposite ends. Provision is made for ceiling mounting, if necessary. Swinging doors in the top of the unit can be opened, when the fans are not running, and the air will flow through the radiator by gravity, furnishing considerable heating capacity.

The radiator consists of two semi-steel headers with tapped holes of special design, into which the ends of copper tubes are expanded by clamping nuts. The headers are without joints, and the tube connections are said to be leakless. Extended surface is applied to the tubes by wrapping them with wedge-shaped copper ribbon, without corrugation, as the manufacturers claim that this construction results in a minimum air resistance through the heater. The radiator units weigh but 272 lbs., and have capacity equivalent to 2000 sq. ft. of cast-iron radiation. Each unit is tested to 250 lbs. hydraulic pressure and is suitable for a working pressure of 100 lbs.

A New Webster Drip Trap

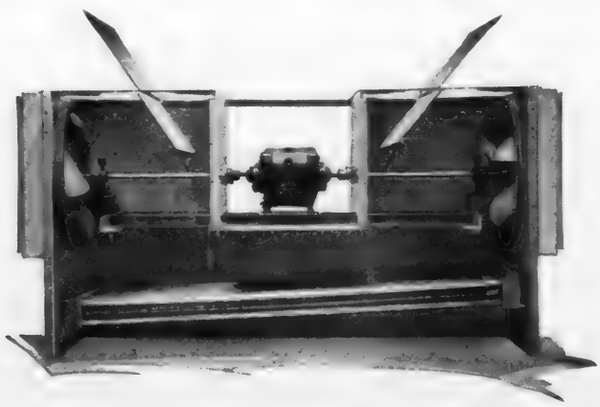
A recent addition to the heating equipment manufactured by Warren Webster & Co., Camden, N. J., is a heavy-duty trap, designed to handle a large volume of condensate and air, and at the same time to be compact and light enough so that it can be mounted on the pipe line without additional support. Having large capacities it can be used for draining condensation from ends of mains, or other low points to "no pressure" wet returns, and for relieving the air from the overhead dry returns.

In its construction is included a float-operated valve for the discharge of water and a thermostatic disc and valve for the discharge of air. Inlet openings on both sides are provided so that both "right-hand" and "left-hand" installations can be accomplished with one

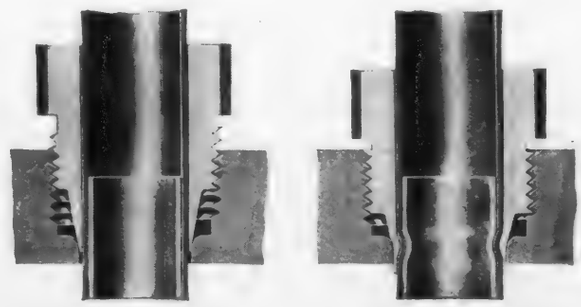


Sectional View of Webster Drip Trap

model. Outlet openings on both the end and the bottom provide for discharge of water, or water and air, either horizontally or vertically to the nearest return line. An opening in the cover permits air to be discharged separately to a dry return when desired. In the bottom of



Twinfan Unit Heater With Front Removed, Showing Heating Unit, Twin Fans and Doors in Top



Details of Tube Joint in Twinfan Radiator Unit

the trap is a plugged opening which serves as a cleanout.

The thermostatic element is fastened to a disc held in place between the body and cover by a bolted-on cap and copper asbestos gasket, and is removable on opening the trap. The float-and-valve assembly also is removable, and two Monel studs with brass nuts hold this unit in place, while a copper asbestos "spark plug type" gasket seals the joint between the valve seat and body. A socket wrench is all that is needed to remove the brass nuts. All interior parts are of brass, copper, Monel or bronze, so that the trap is corrosion-proof.

The Webster drip trap is suitable for draining the condensation and air from mains and from heating surfaces condensing large quantities of steam, such as unit heaters or fan blast coils.

Bulletin 712 announces this drip trap, gives a detailed description of the various ways of installing, and illustrates by diagrammatical drawings and photographs, the trap installed for different situations.

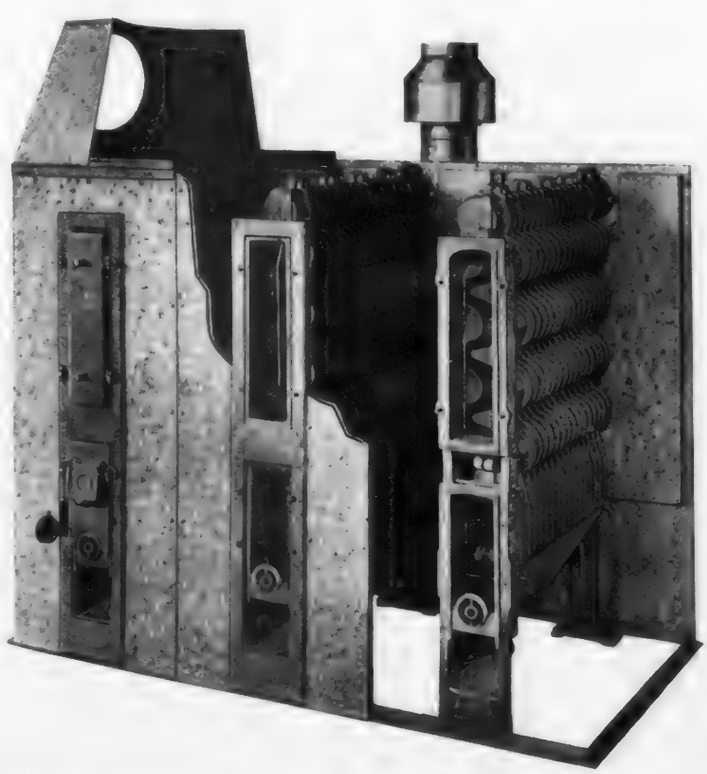
"Gas-Era"—The Richardson & Boynton Warm-Air Furnace

A gas-fired warm-air furnace announced by Richardson & Boynton, New York, eastern sales agent, has been placed upon the market by L. J. Mueller Co., Milwaukee, Wis., manufacturer and western sales agent. The furnace has been designed along multiple-unit lines, and may be had in six sizes, comprised of one to six units, each capable of delivering 64,000 B.T.U. per hour. Units are built up of two cast-iron side pieces, a set of baffles and a burner unit. The side pieces are bolted together with ground joints, no cement being used. They are heavily ribbed, the ribs extending from top to bottom, greatly increasing the surfaces of the combustion chamber and flues. The baffles are so fitted as to cause a maximum scrubbing action of the gases.

The casings are double, reducing radiation, and, in building up the multiple sizes, the casing joints interlock. Casings are shipped from the factory, in the knock-down, the cast-iron units being assembled at the factory. Provision is made for cleaning the interior of the combustion chamber and the flues through ample clean-out doors.

The furnace is shipped with main gas-cock, gas-pressure regulator, magnetic gas-valve, safety pilot for each section, control to limit temperature of air leaving the furnace and a humidifier. The burners are designed for this particular application and have drilled, staggered ports.

Ratings are from 64,000 B.T.U. to 394,000 B.T.U. per hour.



Interior View of Gas-Era Warm-Air Furnace, Showing Ribbed Construction

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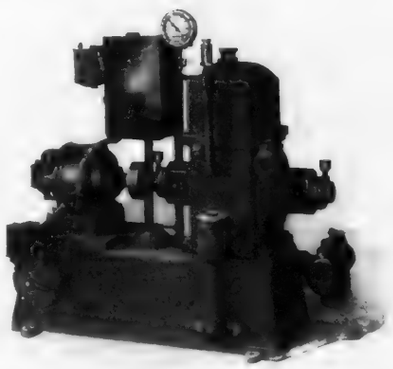
Skidmore Vacuum and Boiler Feed Pump

Embodying many refinements in design induced by several years' use of more than one thousand units, the combined vacuum and boiler feed pumps manufactured by Skidmore Corp., Chicago, appear in a new series of seven sizes.



Skidmore Vacuum and Boiler-Feed Pump

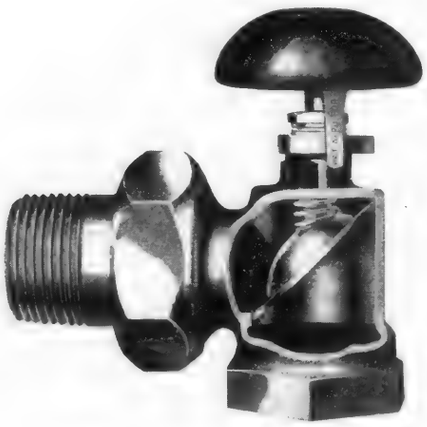
The unit consists of a horizontal motor-driven shaft carrying two pump runners, both being below the fixed water level maintained in the casing. One runner, carrying two concentric vanes with openings in opposite sides, draws condensation, air and vapor from the returns, and delivers them to the casing, which is open to the atmosphere. The other, of the centrifugal type, feeds the boiler from the sump water which is augmented, when necessary, by fresh water supplied from the mains under control of a float-actuated valve. These units are supplied in sizes rated for boilers supplying steam for 5000 to 100,000 sq. ft. of steam radiation.

For return-line heating where radiation and returns are at the same level as the pump, a hollow base is used, on which the pump, motor and electrical controls are mounted. A float-operated switch is installed to control the pump from a water level in the base. The water level on these units is from 10 in. on the smaller sizes to 12 in. on the larger, from the floor level.

CRESCENT CORK BOARD ROOF INSULATION, for reducing heat loss and preventing condensation, is a recent publication of the United Cork Companies, Lyndhurst, N. J. The booklet describes the use of Crescent 100% pure corkboard which, it is stated, may be installed directly upon practically any type of roof construction. After presenting the theory relating to the prevention of condensation and heat loss through roofs, the booklet gives specific examples of how to figure the amount of roof insulation required to prevent condensation or heat loss. In addition to numerous illustrations showing the process of applying the corkboard and typical buildings equipped with this insulation, the booklet contains a roof resistance chart, accompanied by a table of standard-type roofs and their resistance to heat flow. Size 8½ in. by 10½ in. Pp. 24. (A.I.A. 37-b-4).

New Trade Publications

DETROIT EQUALIZING HOT-WATER RADIATOR VALVES are featured in a leaflet and circular letter sent out by American Radiator Co., New York. These valves operate, from closed to full open, with a one-half turn of the handle, the valve being an elliptical swinging plate set on a 45° angle. A headless screw in the collar makes it possible to adjust the individual valves after installation has been completed, and so balance the system.



Cutaway Detroit Equalizing Valve, Showing Swinging Plate

THE 3-IN-1 HEATING SYSTEM is surveyed in two catalogs being distributed by the O-E Specialty Co., Milwaukee, Wis. An explanation of the system's operation is the opening topic. Following is a series of illustrations showing how tests are made of the special fittings used. In the center of each circular is a two-page, blue-tone diagram showing the pipe plan and layout of the O-E vapor-vacuum-pressure system. In conclusion are photographs of buildings where the system is installed. In the smaller catalog the improved, packless, graduated valve, the air exhauster and vacuum valve, and the ball-check water-seal union elbow with adjustable air vent are the special features described. Sizes 8½ in. x 11 in., Pp. 16, and 4¼ in. x 7 in. Pp. 16.

ACHIEVEMENT is the title on the cover of an exceptionally attractive catalog received from The Morrissey Oil Burner Corp., Chicago, Ill., in which the burner manufactured by this company is detailed in its various phases. In the center of the bulletin is a drawing showing the construction of the burner, and each feature is indicated to emphasize the simplicity of the unit. This burner can be installed in any heating plant wherever electricity is available. Each page of the catalog is pleasingly arranged with a simple idea, in box form, briefly presented, and below it a sketch illustrates the idea. At the back are two pages of testimonial letters, and two more pages of pictures showing homes and other buildings where the burner has been installed. The last page summarizes the history and personnel of the company. Size 8½ in. x 11 in. Pp. 24.

MERCOIDS for September contains, as its leading article, "The Relation of the Oil Heating Institute to the Public and the Industry," written by Lionel L. Jacobs, president of the American Oil Burner Association, and managing director of Fess Oil Burners of Canada, Ltd. To quote from this article: "That the Oil Heating Institute is fulfilling one of its major purposes is amply verified from the fact that, in less than three months from its inception, over 10,000 copies of the booklet advising the layman on how to select an oil burner have been applied for and hundreds of applications are waiting the re-issue now in the hands of the printers. . . Another function of the institute has been the clearing up of the uncertainty concerning the question of oil supplies for the future. So well has this been done that today indeed we see many important oil companies themselves financially supporting the work of the institute.

"We must absolutely get away from ourselves thinking the business a seasonable one if we wish to sell the idea to the public that it is not, and after all, with a little readjustment of most of the existing finance schemes, there is every reason why it should not be seasonable."

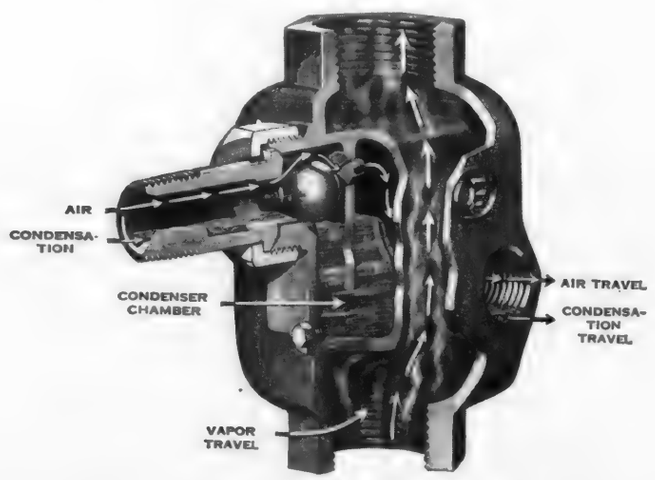
Mercoids is the monthly publication of the Federal Gauge Co., Chicago.

HERE'S HEALTH AND WEALTH is the title of a leaflet describing a line of small exhaust fans manufactured by the Emerson Electric Mfg. Co., St. Louis. The salient features are given in detail on the last page. A steel shaft with ground surfaces is set in extra large bearings. Blades and rings are built of cold-rolled steel. Cup-shaped blades and a special design of supporting ring provide for quiet operation, eliminate waste-air streams, and reduce eddy currents and frictional losses. When the fan operates, the shutters stand out perfectly straight offering little resistance to air currents. They stay tightly shut and weatherproof when the fan is not in use.

Small Emerson Exhaust Fan

A tabulation lists five sizes of fans, from 12 in. to 30 in., with air capacities from 1000 to 6200 cu. ft. per min.

THIS IS WHY! STEEL-RIVETED, captions a folder being circulated by the Kewanee Boiler Co., Kewanee, Ill., in which a story is told of this company's fire-box heating boiler. One advantage, it is pointed out, of the riveted seams in this boiler is that the texture of steel is actually improved by hydraulic pressure and hammer blows. The rivets only need to be heated to cherry red, so there is no fusion or burning of steel, which causes brittleness. There are no locked-up stresses from shrinkage which make it necessary to anneal the joints. Steel heating-boilers, water heaters, garbage burners, tanks and radiators also are mentioned in the leaflet. A large illustration demonstrates the particular features of the steel-riveted boiler.



O-E Frost-Proof Return Fitting

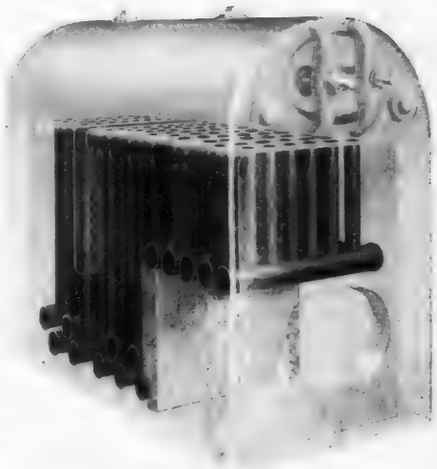
HOW TO HEAT YOUR HOME FOR HEALTH AND COMFORT! is the title on the cover of a booklet distributed by The Holland Furnace Co., Holland, Mich. Within are discussed, the evolution of home heating, the importance of building construction, the beginning of a satisfactory heating system, the necessity of insulating the attic, measurement of heat, the size of heater required, a standard system for heating plans, ventilation and air circulation, humidity and health, and how to heat a home for health and comfort. The remainder of the booklet tells of Holland heating service, its progress, principal features, and the quality of service that is rendered. Size 5½ in. x 8½ in. Pp. 22.

BRYAN OIL AND GAS BOILER is the caption of a recently issued catalog dealing with the oil or gas-burning boiler manufactured by the Bryan Steam Corp., Peru, Ind. A detailed description of the boiler features the design and construction, both of which are distinctive. Stress is laid on the heat-extracting ability of the copper tubes forming the water-tubes of the boiler, and it is stated that full load can be carried with a stack temperature of 300° F., and that working efficiencies of 75% are possible. The catalog covers the subject thoroughly, both in text and illustration, and includes a number of relevant tables. Size 6 in. x 9 in. Pp. 48.

NOKOL NEWS, the monthly publication of The American Nokol Co., Chicago, is starting in the August issue a series of articles on the history of petroleum. The new non-automatic Nokol is announced as a burner adapted to apartment houses, small office buildings and similar loads, where an attendant is available. "Selling the Architect," another feature, is an excerpt from the *Architectural Record*. This brings out points in regard to the influence of the architect and methods of convincing him of the desirability of oil heat.

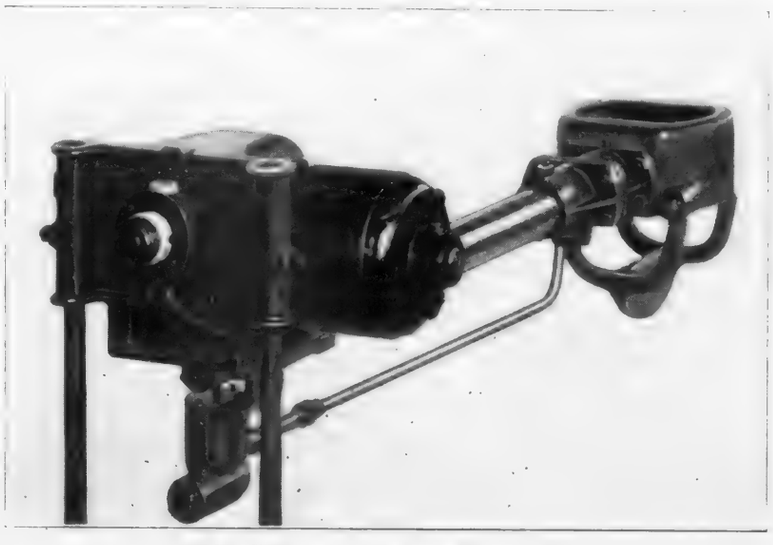
OIL BURNER CONTROLS have been given a particularly artistic setting in a bulletin being circulated by Honeywell Heating Specialties Co., Wabash, Ind. It is an excellent portrayal, by using a harmonious color scheme and attractive typography, of mechanical equipment so featured as to attract involuntary attention. Outlining the various functions of the Honeywell high-low system of automatic temperature-control, the five elements of installation are enumerated and described as the room thermostat, motor switch, masterstat, combustion safety-control and electric oil valve. Different types of thermostats, such as the type R clock thermostat and type Q, are described. A testing and demonstrating base is a special device on which the thermostat is mounted, and demonstrates the sensitiveness of the thermostat to the temperature changes in the room. Type DSS motor switch has a specially designed rotary quick-break switch which controls the starting and stopping of an oil-burner motor, and is particularly arranged to operate in conjunction with type B combustion safety-control. There also are shown the type DS motor switch, differing slightly from the other model in the construction of the switch, and type D control motor which, instead of a switch mechanism, is equipped with extensions for opening or closing dampers or valves. Type DSSV motor-switch valve is furnished with a gas-pilot control valve. By means of a shaft extension from the camshaft of the motor-switch the valve disc is rotated, and holes in the disc and their location control the flow of gas to the pilot. Type B combustion safety-control is designed to be used with type DSS motor switch and type DSSV motor-switch valve, and together they control the operation of the burner. Types A-1 and A-2 electric oil-valves are featured as a late addition to this family of equipment. Front and rear pictures with accompanying text again direct attention to a recent product—the masterstat. All types are tabulated with their specific capacities. Size 8½ in. x 11 in. Pp. 24.

OIL-BURNER TYPE WELDED-STEEL HEATING BOILERS are described in Catalog No. 27 received from Johnston Brothers, Inc., Ferrysburg, Mich. These boilers are a combination of firebox and the water-tube types, the furnace being completely surrounded by a water-wall. An oil burner functions intermittently, and with each start of the burner intense heat is generated almost instantly, so that rapid absorption of the heat by the water, and the direct, vertical, unimpeded water circulation of the boiler, insures immediate delivery of heat to the radiating system. Built of steel throughout, all plates are of firebox steel, and the tubes of hot-rolled seamless steel. Joints and seams are electric-arc welded, and the stays and tubes are welded in place, making a one-piece unit. As a target for the impingement of gases from the nozzle type of burner, a special fire-tile is used at the rear of the firebox to form the primary baffle. The secondary baffle is a water-wall of permanent construction. A special loop of pipe, welded into the rear water-wall provides for domestic hot-water supply. Specifications and prices of these oil-burning boilers are tabulated, and diagrams and phantom views show their salient points. Size 8½ in. x 11 in. Pp. 8.



Johnston Welded Steel Oil-Burning Boiler

THE VERSATILE K is the interest-impelling caption of a circular from the Kewanee Boiler Co., Kewanee, Ill. This literature directs attention to the Type K firebox boilers, designed for loads exceeding 600 sq. ft. of radiation, and the illustrations show typical schools and apartment buildings in which this type is installed.



Nokol Non-Automatic Oil Burner

Trade Name "Koolstack" Used Only for Leader Boilers

Due to the transposition of two pages of copy, a paragraph relating to the Koolstack boiler, a product of the Leader Iron Works, Decatur, Ill., and intended to form the conclusion of an item under the head of "New Trade Publications" for July, was in error attached to an item regarding Bernhard boilers, described under "New Trade Publications" in the August issue. The descriptive trade name "Koolstack" applies only to boilers manufactured by the Leader Iron Works.

THE DEALER'S SIDE OF THE OIL BURNER INDUSTRY is the title of a "somewhat different" booklet prepared by Rickard Engineering Corp., New York. This piece of literature is addressed to prospective oil-burner dealers, and is designed to acquaint them with the high-lights in the oil-burner industry and to tell how this organization proposes to operate. The selling plan contemplates the establishment of agencies, with restricted territories, closely working with the manufacturer in matters of local advertising, installation and service. Suggestions are given for agency organization in small and large communities, for handling installation with a minimum force and for financing an agency during the early stages. There is a comprehensive story of the Rickard burner, with full construction details, and a section outlining the dealer contract. Size 6 in. x 9 in. Pp. 34.

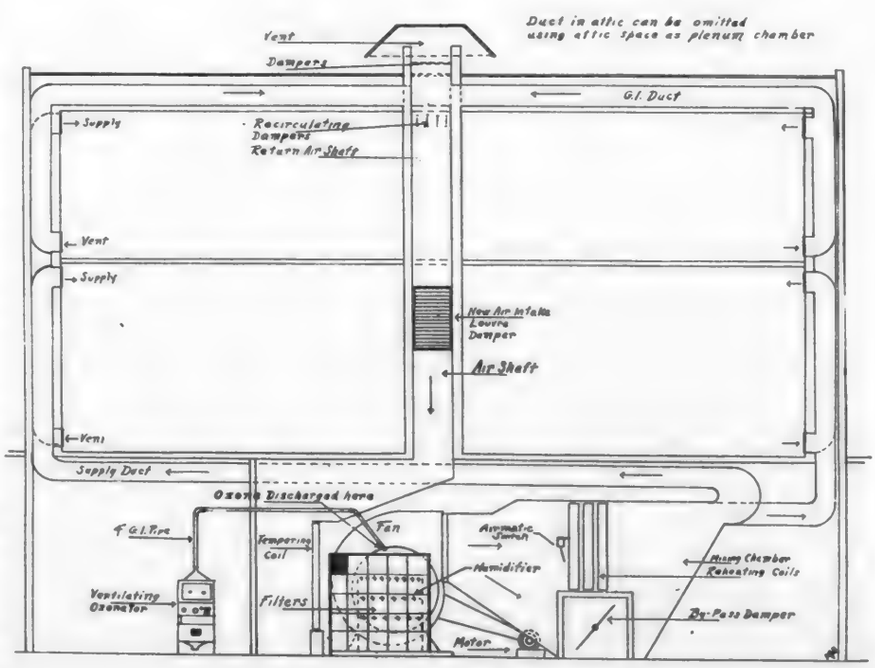
Rickard Oil Burner

LAMMERT OIL BURNING EQUIPMENT is featured in Catalog No. 16, issued by Lammert & Mann Co., Chicago. A supplementary bulletin contains a comprehensive story of the oil-burning equipment developed by this company for various heating and industrial purposes. Completely-automatic burners are listed in four sizes, the largest rated to burn 27 gal. per hour, and to provide for 8000 sq. ft. of steam radiation. A highly developed line is the Lammert portable brick-burning units, which require no foundation or storage tank. These are of the air-atomizing type, and it is stated that installations in brick yards have shown yearly economies, over steam-atomizing burners previously used, equal to their first cost. A line of automatic burners has been brought out for domestic use, burning 28° fuel; another series, in seven sizes, is for semi-automatic use; that is, for operation between high and low limits to maintain fixed boiler pressure. The largest burner of this class will handle 100 gal. of oil per hour, and is adapted to a 300 H.P. boiler. A similar series, with identical capacities, is for manual control, with no automatic regulation. The catalog also lists oil heating and pumping equipment, valves, strainers and atomizing nozzles.

ELECTROLITES, dated September, 1927, appears for the first time as the house organ of Electrol Inc. of Missouri., St. Louis. A message to Electrol salesmen by R. S. Beale, national director of sales, states that the booklet will disseminate, throughout the organization, knowledge and experience gained in the sales field by the company's representatives, and will be a direct source of supply for exchanging ideas through developments and practical experiences that have contributed to the organization's success. A report of the winners in a sales contest during the previous month by the CO_2 Club shows what was accomplished. In the manufacturing notes a new Model TD burner is described as a double-motor unit, using a high-speed motor on the fan, thereby increasing the volume and the velocity of the air, and a low-speed motor on the self-sealing oil pump. Such an arrangement provides a machine capable of carrying about double the capacity of the standard Model T.

ELECTROZONE—PURE AIR AND PURE WATER BY SCIENTIFIC METHODS is the subject of an elaborate catalog demonstrating the products manufactured by the Electrozone Corp., Grand Central Terminal Bldg., New York. Electrozone as used herein means ozone produced electrically, by the silent electric discharge. Two types of ozonators are classified—the industrial and the ventilating—the first for high concentration ozone production, and the second as a low-concentration ozone generator for air purification in public and private buildings. In the pamphlet it is stated that the greatest commercial value of ozone for ventilation lies in the fact that fuel economy can be increased by recirculating from 70% to 90% of the air after purifying it with ozone. Successful application of ozone to large-scale ventilation, it is here remarked, was first accomplished in the St. Louis public schools, and since then this system has extended to school air-conditioning in many cities. Examples given are the Erasmus Hall High School, in Brooklyn, and the San Francisco Public Library. Type BF portable ozonator is offered as the simplest form of equipment in the Electrozone system, a unit suitable for offices and schoolrooms and handling air conditions for 20 to 40 occupants. Other types noted are for use with the unit-ventilator and unit-heater. These elements are available in several sizes up to 2000 cu. ft. per minute capacity, and can be used for both new and alteration jobs. Special types described and illustrated are B, D, F and H. Type F is designed for ventilation in the ventilating duct as at the fan intake, and the ozone is carried away by the moving air which also operates its airmatic switch. Type D is particularly suitable for operation with warm-air furnaces. Similar to this is another type designated as DB, used for delivering ozone to desired points in either ventilation or industrial work such as drying and treating operations. As illustrated, it is enclosed and provided with an auxiliary blower, an ozone-yield regulator, an airmatic switch and a filter. For installation outside of the air chamber type H is equipped with an air filter and dehydrator, and the ozone-air mixture is piped to the fan intake, so that the apparatus can be placed anywhere, regardless of air condition, dust content or humidity.

Purification of water in swimming pools and other public water places is provided for by units mentioned here, as well as by units specified for various industrial processes in which ozone is becoming an increasingly important factor. Size 8¾ in. x 11 in. Pp. 48.



Electrozone System of Ventilation

Death of Albert A. Cary

Albert A. Cary, a charter member of the American Society of Heating and Ventilating Engineers, and long prominent in the consulting engineering field, died in New York, September 6. Mr. Cary was 68 years old. Many of the older members of the A.S.H. & V.E. will remember him best as one of the "Old Guard," which included such figures as Professors Kent, Carpenter, and Allen. In the early days of the society they could always be depended upon to take a prominent part in the discussions at the professional meetings, and the members were always assured of a treat on such occasions. Up until the past year Mr. Cary's interest in the society and in heating and ventilating subjects has been as keen as ever, and his face will be greatly missed, not only at meetings of the society, but at those of the New York Chapter.

Mr. Cary was graduated from the Worcester Polytechnic Institute, and began his mechanical engineering career at an apprenticeship in the Cary Spring Works. Later he became connected with Abendroth & Root, New York. Since 1892 he had been engaged in consulting engineering work.

He had been a member of the American Society of Mechanical Engineers since 1889.

DR. ALEXANDER CROMBIE HUMPHREYS, president of Stevens Institute of Technology, Hoboken, N. J., for 25 years, died August 14 at his home in Morristown, N. J., at the age of 77, after a general breakdown. Doctor Humphreys resigned as head of the institute at the last commencement, but continued to serve as chairman of the board of trustees. He was born in Edinburgh, Scotland, and came to this country when he was eight years old. He was graduated from the Stevens Institute in 1881, and later became chief engineer of the Pintsch Lighting Company. In 1885, he was made chief engineer and general superintendent of the United Gas Improvement Company of Philadelphia, which company absorbed the B. & G. Company with which he previously was connected.

Doctor Humphreys was a member of the firm of Humphreys and Glasgow of London, designers and builders of water-gas plants; Humphreys and Glasgow of New York, consulting engineers, and, later, Humphreys and Miller of New York. He was a member of the "Old Guard" of the gas industry and during his career was the head of many companies, among which were: Norfolk Gas Company, Syracuse Gas Company, Buffalo Gas Company, vice-president and chief engineer, United Coke and Gas Company. He was also a past president of American Society of Mechanical Engineers, American Institute of Consulting Engineers, American Gas Light Association, American Gas Institute, and others.

ROBERT M. STARBUCK, late senior member of R. M. Starbuck & Sons, Inc., Hartford, Conn., died September 2 in his 85th year. He was born in Nantucket, Mass. He retired from business many years ago. Mr. Starbuck, was a well-known writer on plumbing subjects until about 15 years ago when his son, R. M. Starbuck, Jr., took over this part of his work. He was a member of the Republican Club of Hartford and of the Masonic order.

JOHN H. HUSSIE, secretary of the Western Warm-Air Furnace & Supply Co., Omaha, Neb., died September 1, after more than two years' illness. Mr. Hussie was past-president of the N. A. S. M. C. and a prominent figure in the warm-air heating industry.

DAVID J. NEENAN, of the Tri-City Plumbing & Heating Co., East St. Louis, Mo., died July 18. He was a well-known member of the Heating and Piping Contractors East Side Association.

GEORGE A. TYLER, connected with the sales department of the International Heater Co., Utica, N. Y., for more than 50 years, died of heart disease August 25. Mr. Tyler became identified with the heater industry in 1872, when he became connected with Russel Wheeler & Son, continuing that association until it merged with the International company in 1898, remaining there until his death. He was born in Westmoreland, a suburb of Utica, July 5, 1850. Mr. Tyler, for the past 26 years, was a member of the Commercial Travelers' Mutual Accident Association of America, and was prominent in the heating trade throughout the country. In 1922, a dinner was tendered to Mr. Tyler in honor of his fiftieth birthday as a salesman and he was presented by the president of the company with a service pin mounted with five diamond stars, significant of five decades of service.

G. H. SUTHERLAND, president of the G. H. Sutherland Plumbing & Heating Co., Walla Walla, Wash., died July 27, from a heart attack. Mr. Sutherland had been connected with the heating and plumbing business in Walla Walla for 44 years and with the plumbing industry for 53 years. In 1906 the Electric Supply & Fixture Company was incorporated and Mr. Sutherland was also vice-president of this concern until his death. He was born in St. Joseph, Mich., March 16, 1858.

FRANK C. WIGHT, editor of *Engineering News-Record*, died September 18, at his home in Summit, N. J. Mr. Wight was born in Washington, D. C., February 26, 1882. He attended Columbia University from 1899 to 1901, and received his degree as civil engineer from Cornell University in 1904. He had been associated with the *Engineering News* and then the *Engineering News-Record* since 1907. Mr. Wight was a director of the American Construction Council and a member of the American Society of Civil Engineers, the American Concrete Institute, the American Society for Testing Materials and the Engineers' Club.

ROSS P. FLOWERS, of the Honeywell Heating Specialties Company, Wabash, Ind., a well-known figure in the heating industry, particularly the oil-burner field, died suddenly at his home in Chicago, September 5. Mr. Flowers was known throughout the country, having been identified with many progressive moves in the industry. He was one of the organizers of the Chicago Oil Burner Association. Previous to his connection with the Honeywell Company, he was connected with the Gill Oil Burner Company.

New Publications

DIRECTORY OF COMMERICAL TESTING AND COLLEGE RESEARCH LABORATORIES is the title of Miscellaneous Publication No. 90, issued by the Bureau of Standards of the Department of Commerce, Washington, D. C. In this bulletin, containing 42 pages, there is a list of the 207 commercial testing laboratories throughout the country, together with indications of the types of commodities which they are prepared to test. There also is presented a list of the laboratories of 143 colleges which are used not only for purposes of instruction but also to a considerable extent for research work. Price, 15 cents.

Central Station Heating Notes

Eugene, Ore.—Central Heating Company is completing the installation of an additional 308-H.P. Heine boiler in its central heating plant. The installation of 300 ft. of 6-in. underground steam mains to supply additional buildings has just been completed.

Davis, Calif.—Preparations are being made for the construction of a central heating plant for the University Farm in this city. The building to house the plant will cost approximately $18,500, and with the new heating lines to be laid to the Agricultural Engineering Building, the Pomology Building, and the Projected Animal Husbandry Building, the expenditure will be about $50,000.

Kalamazoo, Mich.—A central heating system for the downtown district has been authorized by the City Commission. The proposal, submitted by the Consumers Power Company, is to install a plant which would first serve the downtown section and to have a goodly portion of the system ready for operation at the time cool weather arrives in the fall. It is expected that by the first of the year most of the buildings on Burdick and Main Streets will be connected to the central heating plant. The plant itself will be located in a new building on East Main Street, close to the new bridge over the Kalamazoo River.

Oil Burners for Large Low-Pressure Heating Plants

Ballard. *Mechanical Atomizing Type, Manual Ignition and Control*

Previous articles in this series are:
1. *Todd*, August, 1927. 2. *W. N. Best*, September, 1927.

3. Ballard, Type H.

FIRST in an extensive line of low-pressure mechanical oil burners covering the entire range of burner capabilities, and manufactured by the Ballard Oil Equipment Co., Inc., of New York, was the Type H.

Factors which were observed as primary in its design and subsequent development are proper combustion, adaptability to the heaviest and cheapest grades of oil available, minimum attention requirements, and the avoidance of delicate mechanical or electrical devices.

Probably the most important single factor among these was to produce a burner which would handle the heavy Mexican 12°-14° oil under the conditions characteristic of low-pressure heating p'ants—a burner which can be started easily with cold oil without the need of auxiliary electric or gas preheaters.

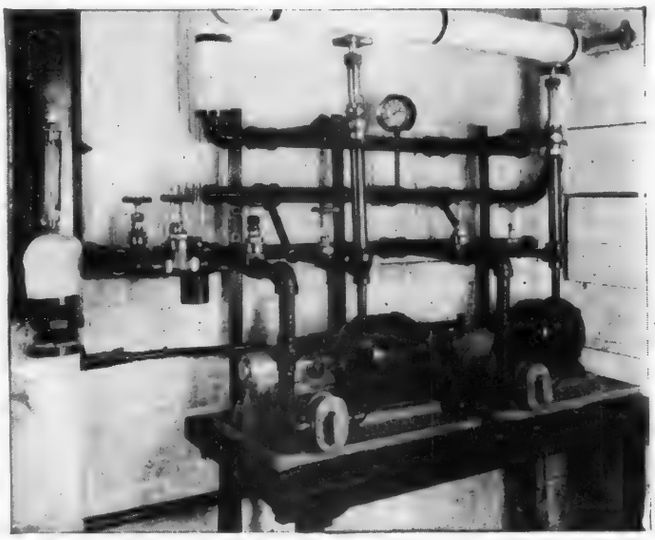
In the accomplishment of this, several interesting and exclusive features were developed. The spinner cup is very long and of large diameter, thus giving the oil, however sluggish and viscous it may be, an opportunity of spreading itself evenly upon the surface of the cup before it reaches the periphery. A sleeve or inner nozzle between the spinner cup and the outer nozzle serves the two-fold purpose of shielding the air blast from the rotating surface of the cup and of permitting the cup to retain the heat that is radiated to it from the flame. The nozzle which discharges the oil into the cup is of ample area so that no excessive pressure is required to force the cold oil through into the cup.

THE BURNER UNIT

A spinner cup and a low-pressure fan are driven by a standard 3450 R.P.M. motor. The motor is quickly and easily replaceable. The safety features on the burner are unique. If, for any reason, the burner should not be operating up to speed, an expanding ring on the motor shaft contracts and releases a weighted arm, closing the oil valve at the burner base. Should an undue amount of heat be generated near the burner base a fusible link melts and allows a weighted arm to shut off the flow of oil. The burner is attached to the boiler front plate by a hinge bracket so that it can be swung out of firing position when not in operation.

SEMI-AUTOMATIC CONTROL

While burners for this class of service are never fitted with the controls of a completely automatic system, the Type H burner is provided with a double sleeve-valve in the oil line and a shutter on the fan suction, both connected to the damper regulator so that any variation in the boiler pressure will produce a proportionate variation in the air and oil delivered to the burner. This synchronous control of both air and oil produces great flexibility under automatic control and presents a big factor in fuel economy in such apartment houses, theatres, garages, etc., where the care of the plant is in the hands of janitors or unlicensed operators whose other duties require them to be away from the boiler room.

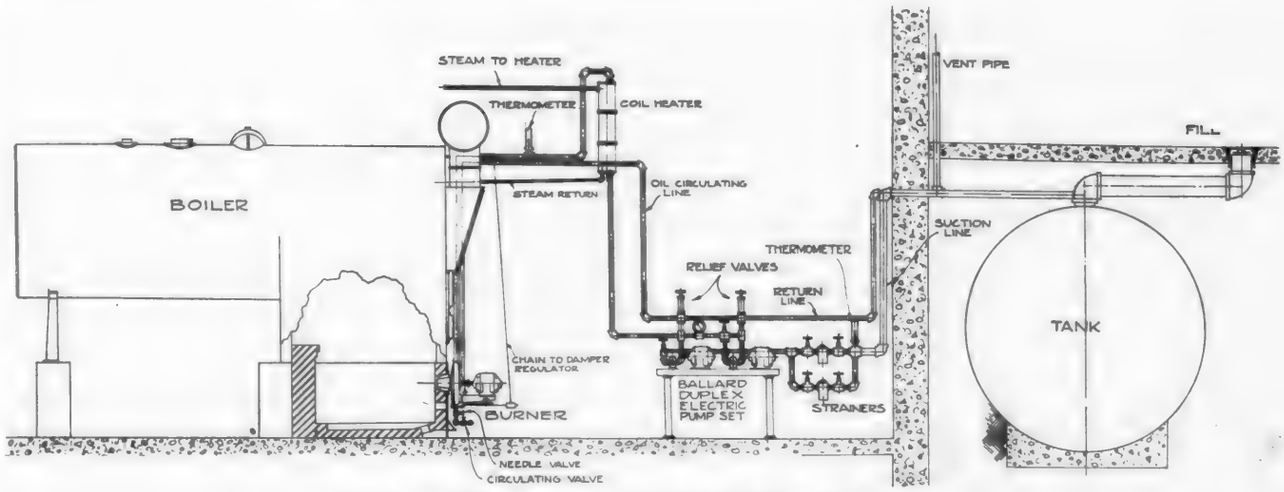


Pump Unit for Burner Using 12°-14° Oil

Installation of Ballard Type H Oil Burners in Two 250 H.P. Boilers and an Auxiliary Service-Water Heater, Showing Pumps and Piping

THE SYSTEM

Oil pumps are of the gear type, electrically driven. While in some instances the pumps are installed singly, in the majority of cases they are installed in duplex units so that one may always be held in reserve as a spare. Oil from the pump passes through a coil heater before reaching the burner. Its pressure is controlled by relief valves at the pumps. The piping is so arranged that excess oil may be passed through the heater and returned to the tank by the circulating line at the burner or it may be returned cold from the relief valves at the pumps. Which method is employed will depend upon the oil temperature required and other conditions peculiar to the job. Except when the oil is cold it is rarely that oil pressure greater than 10 lbs. per square inch is required. The flow of oil through the



Typical Installation Layout For Ballard Type H Equipment

burner is regulated by a needle valve at the burner, operated in conjunction with the automatic control. No gas or electric ignition is provided for this system as it always is advisable for an attendant to be at hand to light the burner and to make such regulations as are necessary before a normal condition of oil temperature is reached.

COMBUSTION CHAMBER

Bricking of the firebox conforms to standard practice. In most instances it is advisable either to raise the boiler setting above the height specified for coal or else to pit the floor under the combustion chamber. This is necessary to insure ample volume of combustion space and to provide clearance between the flame and the firebrick walls. Slight modifications of the nozzle and spinner-cup design adapt the burner to both broad and long fireboxes.

RATING

The burners are built in various sizes having maximum ratings from 30 to 150 H.P., the various sizes well overlapping one another in range. The pumps are built in three sizes, and are always installed at ratings well above the maximum demands of the system.

Tabulation showing the range of capacities follows. It must be understood, however, that a great deal more flexibility is possible than indicated, as each of the three sizes can be made up from any one of several combinations of blower capacity and atomizing-cup size:

Type	For radiation, sq. ft. steam	Fuel capacity, gal. per hour
A	1500—3800	4—10
B	3000—14,000	8—33
C	4000—18,000	9—42

THE PUMP-TYPE UNIT

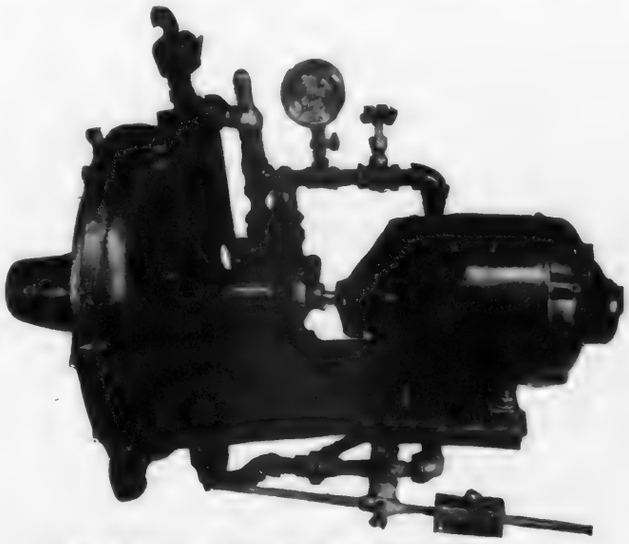
While in most of the large cities, particularly in the northeast, 12°—14° oil is available at prices which make it the most practical fuel for this class of use, there are many sections where oil of lower gravity than 19° is not to be had. For use under these conditions, where it is unnecessary to preheat the oil before burning, a simpler type of installation is made. The separate pump set is replaced by a pump which is incorporated on the burner. Thus the piping is limited to the running of suction and return lines direct from the tank to the burner, the latter incorporating the strainer, pump, relief valve, gauge, needle valve and automatic control-valve. In making such installations, the labor, material, and resultant cost are materially lessened.

ENGINEERING

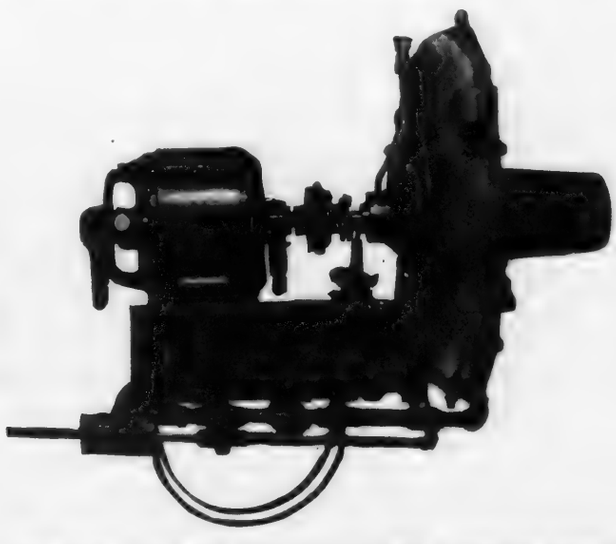
Experience of over twenty years in oil-burning engineering has convinced the Ballard organization that each separate installation presents distinctive features which must be analyzed correctly in order to secure the best results, and that nothing is less profitable than an installation which fails to produce the anticipated results. It has been made a policy that no installation of this equipment shall be made except by the Ballard Oil Equipment Co., or under the supervision of its engineers.

Many burners installed by the Ballard company have seen ten years of service, and it is stated that service calls for mechanical troubles or breakdown are comparatively rare.

Ballard Type H burner is listed by the Underwriters' Laboratories to burn oil not heavier than 12° A.P.I., preheated when necessary.



Type H Ballard Burner With Integral Pump for Burning Lighter Fuels



This Burner Handles 12°-14° Oil With Auxiliary Pumps Shown on Opposite Page

Red Cross Roll Call for 1927

It has been announced that the heating and piping field in New York City will be intensively covered in the 1927 Red Cross Roll by the Heating and Piping group, headed by Henry B. Gombers, secretary of the Heating and Piping Contractors National Association.

Every phase of New York's industrial, mercantile, and professional life will be represented in the roll call organization to secure the maximum public response to the annual membership effort. It is estimated that by the opening of the roll call on Armistice Day, approximately 200 such group committees will be functioning, each under its individual chairman, representing a total of about 1500 of the city's outstanding leaders serving in a volunteer organization.

KIELEY HEATING AND POWER PLANT SPECIALTIES are described in a catalog issued by Kieley & Mueller, Inc., New York. The catalog presents data on Kieley high-pressure pilot regulating valve, the Eureka pressure regulator for ordinary heating systems, regulating and reducing valves, a piston-actuated float valve for cold water, the Kieley standard steam trap for both high and low pressure, a rapid water feeder and a duplex feeder, designed to make up water when and as necessary to boilers, and to discharge excess water entrained in the steam lines. These last are especially recommended for boilers using oil fuel, preventing the flooding of the boiler in the event of excess returns and supplying make-up water to maintain a determined water level. Size 3 in. x 5 in. Pp. 18.

Oil-Fired Pacific Boiler Under Test in San Francisco Hotel Shows High Efficiency

A SERIES of tests recently made on one of a pair of Pacific rear-fired boilers in the Mark Hopkins Hotel, San Francisco, by Leland and Haley, consulting engineers, of that city, is an interesting index of operating characteristics of these boilers when oil fired.

From the report of these engineers the following is quoted:

"The boiler used is one of two heating boilers installed for the regular heating service of the hotel. The one tested furnished steam to the heating system during the entire tests, and was operated under the actual conditions for which it was designed, and after about five months' service.

"The first test was made with all the steam generated being used in the heating system of the building. The second test was made with an 8-in. by-pass valve opened half way so that a portion of the steam generated was discharged directly to the atmosphere through a 6-in. pipe, the house system still using all the steam it required. In the third test the by-pass valve was opened full, and the boiler operated with a heavy fire.

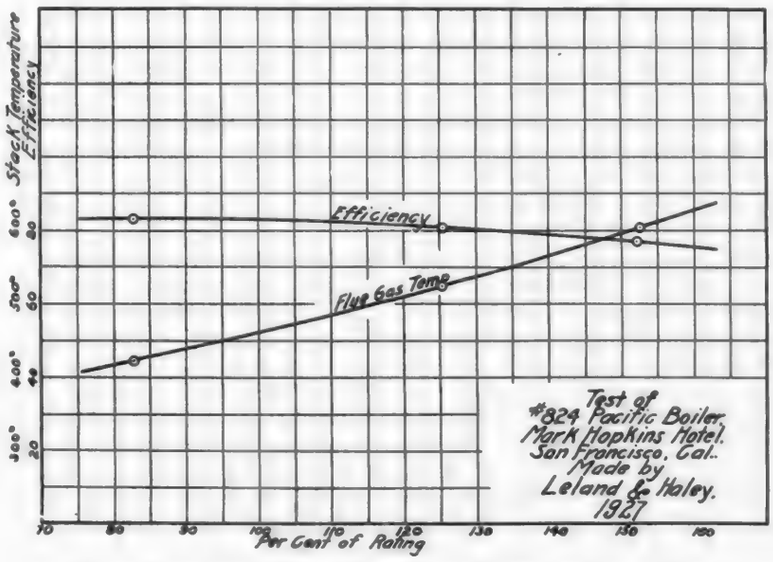
"The third test was run for a period of four hours. Condensation from the heating system, together with the necessary cold make-up water, was taken to the weighing tank for boiler feed.

"An 8-in. steam separator was installed in the main steam-line from the boiler, and all the water collected was weighed as often as it showed nearly full in the water glass on the separator. During tests Nos. 1 and 2 this separator filled on two occasions, probably due to a sudden load being thrown on the boiler by the opening of some of the heating units.

"During test No. 3 there was no evidence at all of any priming, and it was not necessary to weigh the water in the separator oftener than about once every

TEST OF PACIFIC BOILER IN MARK HOPKINS HOTEL

1.	Test number	1	2	3
2.	Duration of test, hours	8	8	4
	Average Pressures, Temperatures:			
3.	Steam pressure, lbs. sq. in.	.79	.48	.44
4.	Room temperature, degrees F.	81.4	89.0	77.0
5.	Feed water temperature, degrees F.	105.7	97.4	86.0
6.	Flue temperature, degrees F.	422.0	522.0	603.0
7.	Draft in furnace, in. water	.19	.21	.19
8.	Draft in breeching, in. water	.27	.36	.30
9.	Factor of evaporation	1.1106	1.1186	1.1303
10.	CO_2 in flue gases, per cent	.....	12.34	13.26
11.	Heat value of oil, B.T.U.	18,645	18,645	18,645
	Total Quantities:			
12.	Fuel oil as fired, lbs.	1,437	2,251	1,429
13.	Water fed to boiler, lbs.	20,881	31,300	18,839
14.	Water collected in separator, lbs.	263.5	229.5	176.
15.	Per cent of total feed in separator, per cent.	1.243	.734	.93
16.	Total equivalent evaporation, less separator, lbs.	22,896	34,759	21,094
17.	Separator correction $\frac{W \times Q}{L}$, lbs.	30	27	23
18.	Corrected equivalent evaporation, lbs.	22,926	34,786	21,117
	Hourly Quantities and Capacity:			
19.	Fuel oil consumed, lbs. per hour	179.6	281.4	357.2
20.	Equivalent evaporation, lbs. per hour	2865.7	4348.2	5279.2
21.	Capacity developed (1 sq. ft. = 240 B.T.U.) sq. ft. radiation	11,587	17,581	21,346
22.	Catalog rating, sq. ft. radiation	14,000	14,000	14,000
23.	Percent of rating developed	82.8	125.6	152.4
	Economy:			
24.	Equivalent evaporation per pound of oil, lbs.	15.96	15.45	14.78
25.	Overall efficiency of boiler $\frac{\text{item 24} \times 970.4}{\text{item 11}}$, per cent	83.05	80.42	76.91



These Curves are Plotted From Data Taken in Service Test

hour. In fact the separator was emptied seven times during the 8 hours, from 22 lbs. to 28 lbs. being taken each time.

"The oil-burning equipment was a No. 2 Fess unit, temporarily installed for the purpose, using the regular burners installed with the boilers. During the third test a No. 3 blower unit was used so as to be able to get a maximum fire. In all the tests two No. 1 Fess turbine burners were used in the boiler.

"The boiler tubes were cleaned just before the first test and were not touched thereafter. After the first test the boiler was found to be rather muddy and it was blown down and washed out.

"In determining the total equivalent evaporation, the water from the separator was deducted from the total amount fed to the boiler, and then the heat of the liquid was credited to the remainder as a just credit to the boiler.

"Standard heavy California fuel oil was used having a heat value of 18,645 B.T.U. per pound. The oil was fired at its natural temperature without any artificial heating. Water was fed to the boiler from a surge tank by a centrifugal pump.

"The boiler was fired from the rear, that is, the burners were installed in the boiler base just under the rear uptake, and the flame directed toward the front of furnace. The products of combustion passed to the front around the drum, returning to rear uptake, and then passed through the lower and upper bank of tubes to the smoke bonnet.

"The boiler has a total of 205.1 sq. ft. of direct heating surface in water legs, bottom of shell and lower part of rear head, and 783.7 sq. ft. of indirect heating surface in tubes and front head, making a total of 988.8 sq. ft."

Hoffman Specialty Co., Inc., 25 West 45th St., New York, is featuring a painting by the artist, Norman Rockwell, which shows a genial old fellow in his easy chair beside a radiator fitted with a Hoffman valve. The title of the painting is "Hot—You'd Be Surprised."

Important Merger of Oil-Burner Manufacturers

AT the moment of going to press the following telegram was received.

EDITOR THE HEATING AND VENTILATING MAGAZINE:

We announce the merger of Aetna Automatic Oil Burner Incorporated of Providence, Rhode Island, with the American Nokol Company, of Chicago. The business will be carried on under the name of the American Nokol Company, with Morgan J. Hammers, president, and A. B. Frenier and John Scheminger, vice-presidents. Offices and plant of Aetna Company will be moved to Chicago and all present models of both manufacturers continued.

(Signed) American Nokol Company,
By Morgan J. Hammers, president,
John Scheminger, vice-president,
A. B. Frenier, vice-president.

Both the American Nokol Company, of Chicago, and the Aetna Automatic Oil Burner, Inc., of Providence, R. I., are pioneers in the oil-heating business and have a long record of achievement behind them. In many ways their careers have been remarkably similar. They both started out to make a reality of the dream of oil heat for homes nearly twelve years ago, the Aetna devoting their efforts to the development of the light fuel-oil type of burner, and the Nokol the furnace-oil type.

Nokol has been eminently successful in the domestic-heating field where small boilers are to be fired, and furnace-oil is available. Aetna has made an enviable record for economy and efficiency in larger domestic installations and in commercial jobs, such as apartment houses, hotels, churches, office buildings and manufacturing plants.

It is an interesting fact that the idea for this merger originally was conveyed to the executives of both companies through their own dealer organizations. Many Nokol dealers began to take on the Aetna for the larger installations to fill this particular need. A number of Aetna dealers, recognizing the advantages of the Nokol for the smaller home installations, began to handle the Nokol. Soon the heads of both businesses saw the advantage of combining their resources and organizations in order to cover, under one management, the entire scope of the field, and this merger was the result.

The new concern will continue manufacturing all present models of both burners, and both machines will be handled by Nokol and Aetna dealers throughout the country.

VALVE WORLD for July, 1927, the monthly periodical of Crane Co., Chicago, illustrates on its front cover a pipe coil made of 8 in. steel pipe, comprising seven U-bends connected with cast-iron companion flanges. The coil measures 11 ft. by 8 ft. The pipe is 28 lb., and the radius of the bends is 48 in.

This coil is to go in a tank in the plant of the Lethbridge Breweries, Lethbridge, Alberta, for the purpose of carrying steam for heating the contents of the tank, which is 13 ft. in diameter.

Morgan J. Hammers, John Scheminger, Jr., and A. B. Frenier, Executives, American Nokol Company

Present Accepted Practice in Domestic Oil Burners

Remington. *Vaporizing, High-Low with Atmospheric and Mechanical Draft*

Previous articles in this series are:

1. *Kleen Heet*, July, 1925.
2. *Baker*, July, 1925.
3. *Kerrihard*, July, 1925.
4. *Silent Glow*, August, 1925.
5. *Aetna*, August, 1925.
6. *Caloroil*, September, 1925.
7. *Oil-O-Matic*, September, 1925.
8. *Chalmers*, October, 1925.
9. *Hart*, October, 1925.
10. *Sun*, October, 1925.
11. *Rayfield*, November, 1925.
12. *A. B. C.*, November, 1925.
13. *Electrol*, December, 1925.
14. *Grant*, January, 1926.
15. *Nu-Way*, January, 1926.
16. *Wayne*, February, 1926.
17. *May*, February, 1926.
18. *Ray Rotary*, March, 1926.
19. *Super Oil Heator*, May, 1926.
20. *Nokol*, July, 1926.
21. *Johnson*, August, 1926.
22. *Arrow*, September, 1926.
23. *Safe Fire*, October, 1926.
24. *Sword*, November, 1926.
25. *Hardinge*, January, 1927.
26. *Petro*, February, 1927.
27. *Sundstrand*, March, 1927.
28. *Northern*, May, 1927.
29. *Vesta*, June, 1927.
30. *Marr*, July, 1927.
31. *Aladdin*, August, 1927.

32. Remington

AN unusual scheme of operation and construction marks the Remington oil burner, manufactured by Remington Oil Engine, Inc., Newark, N. J. This burner functions on the high-low cycle, utilizing the atmospheric draft of the chimney when the burner is coasting, and taking air from a blower when wide open. It is a pot-type unit, designed for fuels of the furnace-oil class, but the pot is used as a distillation sump, and combustion takes place above it, not in it.

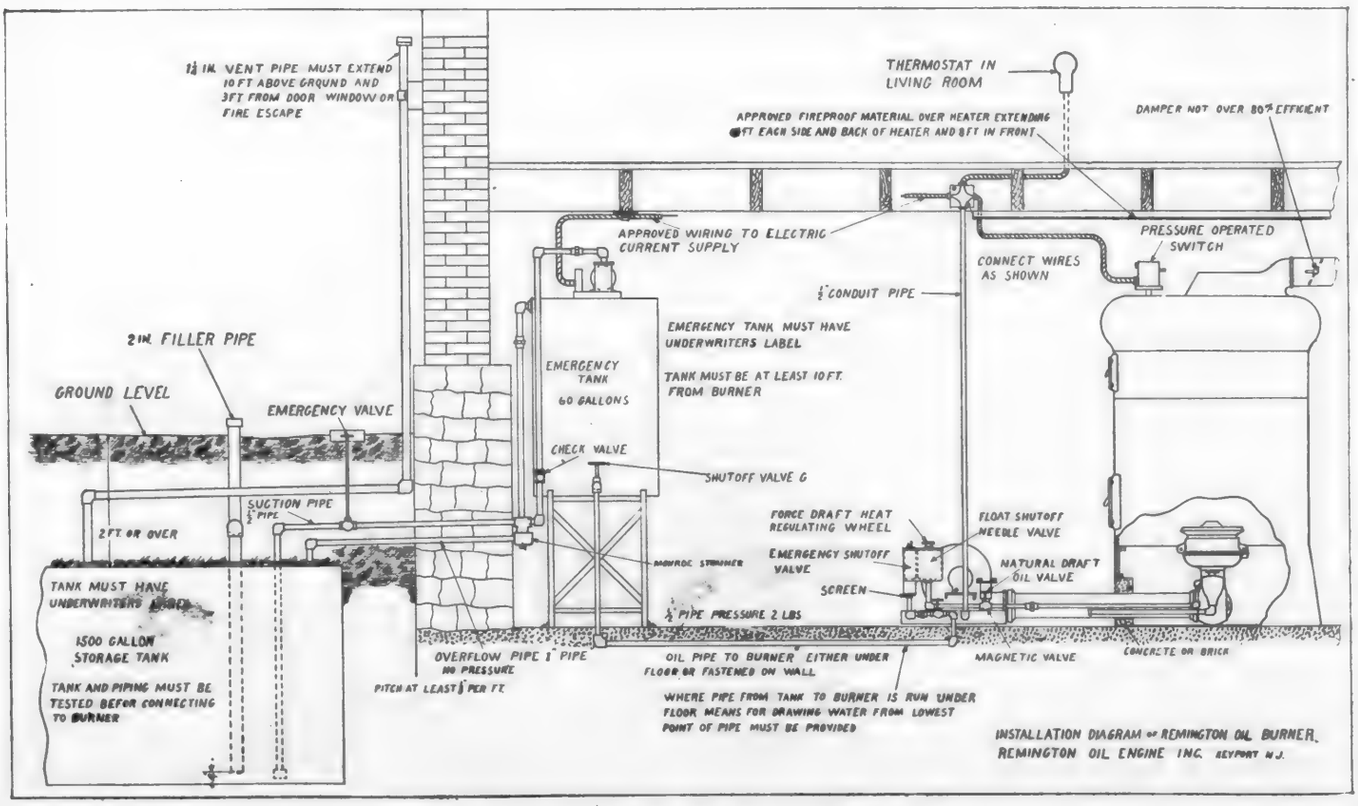
OIL-LEVEL REGULATOR

Oil is supplied to the burner by gravity from an elevated service tank. After passing through the filter, oil enters the control device through a hole drilled in the casing, passing up through a hollow stud to the inside of a copper bellows-diaphragm. A needle-type valve in the top of the bellows is actuated by a metal float. By means of a knurled nut the vertical location of the needle-valve opening can be so adjusted as to cause the valve to function at any level within the limits of the chamber. By this means, when the burner is installed, the proper maximum oil-level in the vaporizing bowl can be provided for.

The burner is built as a single unit, having a vaporizing bowl at one end of a blast-tube and at the other a three-blade motor-driven aluminum fan of the paddle-wheel type, with the oil-level control.

FUNCTIONING OF THE MIXING BOWL

The vaporizing or mixing bowl is an iron casting, shaped like an old-fashioned cuspidor, with the cover piece, which forms the neck of the opening, of carborundum. The bottom of the mixing bowl is turned up around a circular opening in its center, through which the air from the blast-tube enters. Above this opening, and set on a stud passing up its axis, is a carborundum deflector, in the shape of an inverted cone. The design of the mixing bowl and the deflector, and their relative location, constitute a Venturi opening through which the mixture of oil-gas, distilled from the surface of the oil in the mixing chamber, and the air from the blast-tube, are drawn—by the chimney draft, when the burner is on "low"—or forced, when the burner is operating at maximum flame.


1¼ IN. VENT PIPE MUST EXTEND 10 FT ABOVE GROUND AND 3FT FROM DOOR WINDOW OR FIRE ESCAPE
THERMOSTAT IN LIVING ROOM
APPROVED FIREPROOF MATERIAL OVER HEATER EXTENDING 6FT EACH SIDE AND BACK OF HEATER AND 8FT IN FRONT
DAMPER NOT OVER 80% EFFICIENT
APPROVED WIRING TO ELECTRIC CURRENT SUPPLY
PRESSURE OPERATED SWITCH
CONNECT WIRES AS SHOWN
½ CONDUIT PIPE
2 IN. FILLER PIPE
EMERGENCY TANK MUST HAVE UNDERWRITERS LABEL
EMERGENCY TANK 60 GALLONS
TANK MUST BE AT LEAST 10 FT. FROM BURNER
GROUND LEVEL
EMERGENCY VALVE
CHECK VALVE
SHUTOFF VALVE G
SUCTION PIPE ½ PIPE
FORCE DRAFT HEAT REGULATING WHEEL
FLOAT SHUTOFF NEEDLE VALVE
2FT OR OVER
MONROE STRAINER
EMERGENCY SHUTOFF VALVE
NATURAL DRAFT OIL VALVE
SCREEN
TANK MUST HAVE UNDERWRITERS LABEL
1500 GALLON STORAGE TANK
TANK AND PIPING MUST BE TESTED BEFOR CONNECTING TO BURNER
½ PIPE PRESSURE 2 LBS
OVERFLOW PIPE 1" PIPE NO PRESSURE
PITCH AT LEAST ¼" PER FT.
OIL PIPE TO BURNER EITHER UNDER FLOOR OR FASTENED ON WALL
MAGNETIC VALVE
CONCRETE OR BRICK
WHERE PIPE FROM TANK TO BURNER IS RUN UNDER FLOOR MEANS FOR DRAWING WATER FROM LOWEST POINT OF PIPE MUST BE PROVIDED
INSTALLATION DIAGRAM OF REMINGTON OIL BURNER
REMINGTON OIL ENGINE INC. NEWPORT N.J.

Typical Installation Plan for Remington Oil Burner

Remington Burner in a Large Sectional Boiler

Oil is fed to the burner from the level-regulating tank through a magnetic valve, the function of which is to increase the oil feed when the fan is in operation. The valve magnet-coil is wired in multiple with the fan motor, and, when the fan starts, this valve of the needle type is lifted from its seat, and held open while the fan motor is running. When this valve is closed, oil for the low flame is fed through a by-pass that can be set to control the size of the low flame.

The oil then passes to a preheating chamber, integral with, and beneath, the mixing chamber. As the burner is in continuous operation, this chamber always is hot, and the oil is preheated well toward the point of gasification. This hot oil is fed into the bottom of the mixing chamber, where its level is maintained by the outer level-control chamber.

THE ACTION OF THE REFRACTORIES

As the upper portion of the mixing chamber and the inverted cone, forming a spreader for the air blast, are carborundum, there always is present a source of radiant heat acting on the surface of the oil in the bottom of the chamber. When the rate of combustion increases, under influence of the fan blast and increased oil feed, these parts become almost white-hot, greatly increasing the heat emission—hence the rate of gasification.

The mixture of heated gas and air rises through the throat of the Venturi, and combustion is accomplished above the top of the mixing chamber.

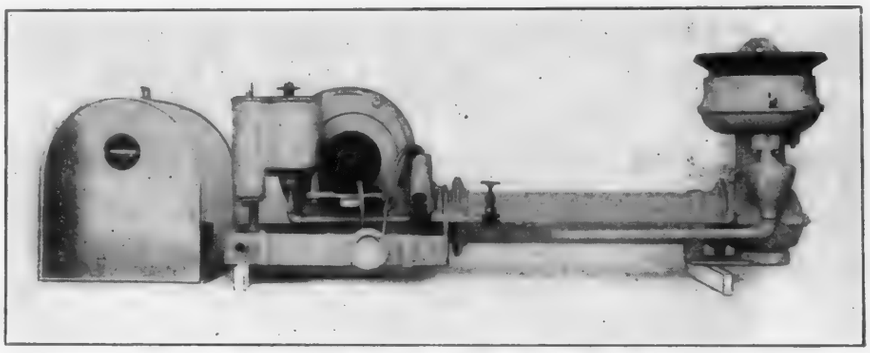
The Remington burner is manufactured in three sizes. The Junior is adapted to heating plants serving less than 650 sq. ft. of steam radiation. The Standard-Single will supply heat for 1300 sq. ft. and the Standard-Double, with twin mixing-chambers is adapted to boilers rating up to 5000 sq. ft.

All types are installed through the ash-pit door-opening, and no bricking is necessary.

CONTROLS

Mercoid controls, operating direct on the 110-volt lines, are used in a simple circuit to start and stop the fan motor.

The Remington burner is listed by the Underwriters' Laboratories to burn oil fuels not heavier than 36° A.P.I.



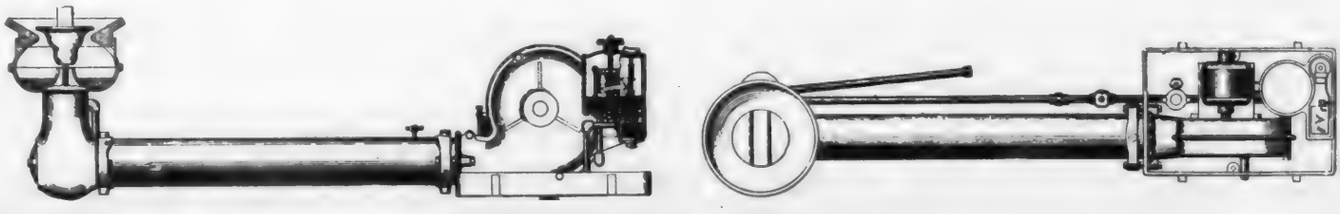
Remington Boiler With Cover Removed

Meeting of the Chicago Oil Burner Association

In view of the fact that Chicago is to be the convention city for the next meeting of the American Oil Burner Association, April 3-5, 1928, with the Stevens Hotel as convention headquarters, special interest attached to the address of Harley C. Darlington, of the Stevens Hotel, at the August meeting of the Chicago Oil Burner Association, at the Allerton Club, August 9. Over 50 members and guests were in attendance. Mr. Darlington stated that the Stevens Hotel had available for exhibit purposes 35,000 sq. ft., and that each column in the exhibit hall provided connections for gas, water, steam, electricity, air and telephone. Exhibitors have at their disposal a 10-ton elevator and switchboard facilities, the light plant provides for the needs of a city of 15,000 people, and the water pumping facilities are equal to a plant fulfilling the needs of a city of 60,000 people.

In connection with the Association golf tournament, J. H. McIlvaine was awarded possession of the Risher Cup for one year; prizes were awarded to J. B. Arthur, C. B. Corin, D. M. Durkee, H. V. P. Block, A. M. Wilkins, J. A. Adamson, W. Z. Rea and W. E. Foskett.

Commerce Petroleum Company was elected to membership, and L. A. Patzke, of the Rayfield Mfg. Company, to affiliate membership.



Partial Section and Plan of Remington Burner

After 22 Years

STATE NORMAL TRAINING SCHOOL
New Building
BRIDGEWATER, MASSACHUSETTS

Architect: Guy Lowell, Boston, Mass.
Engineers: R. D. Kimball Co., Boston, Mass.
Heating Contractors: Hobart & Farrell, Brockton, Mass.

Above: Albert Gardner Boyden Gymnasium

Below: New Training School Building

Powers Control Installed here in 1904

Powers Control Installed in these buildings ~ 1926

NO heat will go to waste and there will be no discomfort or sickness caused by overheated rooms in the new State Schools at Bridgewater.

Profiting by more than twenty years of accurate and dependable temperature control in their older buildings, those responsible for the selection of regulation in the two new buildings shown at the left, specified Powers Control again.

The comments in the letter written by Mr. Annis, the Chief Engineer in charge of all the State School Buildings at Bridgewater, are typical of hundreds of other users of Powers Control.

While the first cost of Powers Control is usually higher than other systems, it often gives twenty to thirty years of accurate and dependable service without frequent adjustments, repairs and "SERVICE" bills, and for this reason it is worth more, yet it really costs less in the end.

Above:
New Normal
School Building

THE POWERS
36 years of specializa
2718 Greenview

Atlanta
Baltimore
Boston
Buffalo
Butte, Mont.
Charlotte, N. C.
Cincinnati
Cleveland
Denver
Des Moines
Detroit
El Paso
Hartford, Conn.
Houston
Indianapolis
Kansas City
Los Angeles
Louisville
Milwaukee
Minneapolis
Nashville
New Orleans

Trade and Miscellaneous Notes

Coming Events

October 10-14, 1927. Ninth annual convention of the American Gas Association at Chicago, Ill. Headquarters at the Hotel Stevens.

October 17-21, 1927. Fifty-sixth annual convention of the American Public Health Association at Cincinnati, O.

December 1-3, 1927. Sixth annual convention of the American Construction Council at St. Louis, Mo. Headquarters at the Statler Hotel.

December 5-9, 1927. Annual meeting of the American Society of Mechanical Engineers in New York. Headquarters at the Societies' Building, 29 West 39th Street.

December 5-10, 1927. Sixth National Exposition of Power and Mechanical Engineering in New York. Headquarters at the Grand Central Palace.

January 23-26, 1928. Annual meeting of the American Society of Heating and Ventilating Engineers in New York. Headquarters at the Hotel Pennsylvania.

Miscellaneous Notes

Dr. Charles W. Brabbee, of the research staff of American Radiator Co., New York, has been in Wiesbaden, Germany, to attend the meeting of the heating and ventilating engineers of Europe, where over 1000 of the leading engineers of that continent gathered. Doctor Brabbée was delegated to carry the greetings of the American Society of Heating and Ventilating Engineers.

Heating and Piping Contractors Boston Association held an outing August 30, at the North Shore Golf and Tennis Club, Salem, Mass. Over 200 men attended, and the program consisted of a gall game, golf tournament and contests, tennis matches and other amusement. At the evening banquet over 65 prizes were distributed. The committee in charge of arrangements was: Ted Keefe, E. T. Keefe Company, President Maurice Chase; Coll Flint, H. B. Smith Company; F. H. Tuttle, Warren Webster & Company; A. A. Gatheman, Byers Pipe Company; Henry Lynch, Hodge Boiler Works; Joe Dwyer, J. P. Dwyer Co.

Asbestos Board of Trade of New York, 101 Park Avenue, has established a central survey bureau to secure correct interpretation of specifications and to furnish its members with accurate quantities for figuring estimates on insulation work in connection with heating, ventilating, plumbing and refrigerating systems in the Metropolitan district.

Dr. F. E. Giesecke, until recently professor of Architectural Engineering at the University of Texas, has returned to the Agricultural and Mechanical College of Texas, College Station, Texas, as director of the Engineering Experiment Station.

Heating and Piping Contractors Cleveland Association held its annual picnic August 23, at Geauga Lake. Over 300 members and guests participated in the outing which included a baseball game in the afternoon, followed by dancing in the evening. A. R. Herske, manager of the association, was in charge of arrangements.

Samuel R. Lewis, chairman of the Committee on Research, American Society of Heating and Ventilating Engineers, will be the speaker at the first fall meeting of the New York Chapter of the society, October 17.

New Home
of
Autovent Fans
Uniblade Blowers
Autovent Unit Heaters

Located at:
1805-1827 *N. Kostner Ave.*
CHICAGO

New!

Factory and Gen'l Offices

Out in Chicago's new west-side manufacturing district, you will find the Autovent factory and general offices. The location is ideal.

The building itself allows every process of manufacture and assembly to be carried out on one floor. This means greater speed and vital economies in production.

"Gaining and Holding Good-Will"
This proves it!

ELEVEN years ago we started building good equipment, thereby building good-will.

Today a new factory, completely equipped, is direct evidence of our intention to continue that policy.

We hope that this recent expansion will bring us many more friends than ever before and help to store up added good will.

Cheerful service is our aim. Right now you are probably thinking about Autovent Unit Heaters and will want heating layouts and other Engineering Data. Call on us for this service!

In all our history we were never better equipped to help you. Have you our new catalog No. 110?

AUTOVENT FAN & BLOWER CO. 1805-27 N. Kostner Ave. CHICAGO

Building Operations for August, 1927, as reported by the F. W. Dodge Corporation, showed an increase of 3% over the July, 1927, total, but were 8% under the amount reported in August of last year. The figures for 37 States are $552,487,900. Of this amount 38% was for residential buildings; 22% for public work and utilities; 14% for commercial buildings, 7% for industrial buildings, and 7% for educational projects. The decrease from August, 1926, has no great significance, the report states, because that month happened to be the peak of 1926 contract-letting.

Ira E. Baker, secretary of The Cleveland Gas Burner & Appliance Company, and vice-president of The Barber Gas Burner Sales Company, of Cleveland, was married September 3. Mr. and Mrs. Baker spent their honeymoon in Quebec.

New York Steam Corp., New York, reports record profits for the year; common stock has earned $16.37 a share and net operating earnings have been $1,684,165, gross earnings being $5,977,426. The company also reported record expansion of business. During the year 33,749 feet of mains and services were laid, representing a growth of 16% in the length of the distribution system, and contracts representing estimated additional annual revenue of $1,645,000 were signed, compared with $1,392,000 of new business secured during the previous year.

Cast Iron Pipe Research Association, it is announced, has taken definite steps toward becoming a member of the American Engineering Standards Committee.

New York University, New York City, is offering a special three-year evening course in heating and ventilating, which begins the second week in September and continues for 10 months each year. It is stated that the first-year courses will include mechanical and free-hand drawing, practical mathematics, and elements of heat and heating systems. The second term will include practical mathematics, the theory of heat, the chemistry of engineering materials, and the students will devote some time in the heating and ventilating laboratory. The final year will be the study of the principles of heating and ventilating design and the application of these principles.

Associated General Contractors of America, representing 2300 general contracting firms, with headquarters in 40 different States, will hold a National Construction Exposition in the West Baden Springs Hotel, West Baden, Ind., January 23-27. A series of exhibits will demonstrate all types of construction materials, supplies and accessories for industrial, engineering, and specialty building projects.

Manufacturers' Notes

Summerheat Corporation of America, Dowagiac, Mich., announces the election of George K. Culp as president and general manager.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., announces the following changes in personnel: R. L. Wilson, formerly works manager, has been appointed assistant to the vice-president and general manager; J. M. Hipple, manager of the company's motor engineering department, is now works manager.

American Radiator Co., New York, has appointed Dan Bass, formerly with the Bowles Company, as sales manager of the Seattle Branch. H. J. Dutton, formerly with Power Plant Engineering Company, has joined the city sales force of the Seattle branch.

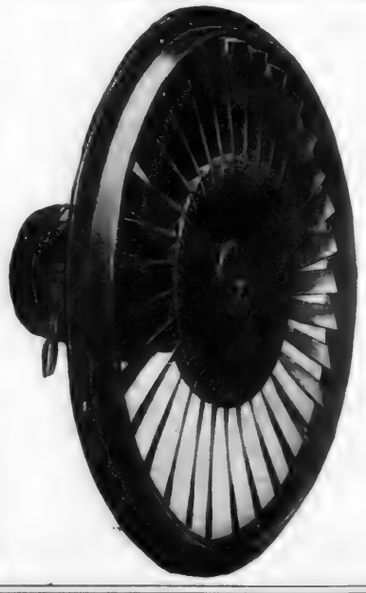
Gorton & Lidgerwood Co., 96 Liberty St., New York, has appointed Charles L. Streeter sales representative for the Gorton single pipe vapor heating system in Detroit and the vicinity. Headquarters are at 952 Merrick Avenue, Detroit.

L. J. Mueller Furnace Co., Milwaukee, Wis., announces the appointment of E. V. Daily as Pacific coast distributor for Gas-Era warm-air furnaces and Gas-Era steam, vapor and water boilers. Mr. Daily, for the past 11 years, has served as manager of the Gasteam department of James B. Clow and Sons, Chicago.

"THE PRESSURE FAN Unsurpassed"

ANNOUNCEMENT—District Managers Wanted

DE BOTHEZAT IMPELLER CO., Inc., MANUFACTURERS of the "DISC PRESSURE FAN unsurpassed", in contemplating further expansion of its organization requires several experienced men to take charge of District Offices as DIRECT FACTORY REPRESENTATIVES. Men acquainted in the INDUSTRIAL FIELD preferred. We invite correspondence. Please give full particulars as to your past experience.



Some Prominent Users of
DE BOTHEZAT DISC PRESSURE FANS

New York Telephone Co., N. Y. C.
Western Union Telegraph Co., N. Y. C.
American Chicle Co., Long Island City
National Biscuit Co., N. Y. C.
Standard Oil Co. of N. J., Bayonne, N. J.
American Can Co., All Plants
Loft Candy Co., N. Y. C.
Western Electric Co., N. Y. C.
Peerless Unit Ventilation Co., L. I. City
Richard Hellman Co., Long Island City
Montreal Light, Heat & Power Consolidated, Montreal, Canada
Knox Hat Co., Brooklyn, N. Y.
New Process Cork Co., Brooklyn, N. Y.
Wendell & Evans Laundries, N. Y. C.
International Motor Co., Long Island City, N. Y.
Skinner Bros., Inc., New York City
Industrial Dryer Corp., Stamford, Conn.
American Metal Cap Co., B'klyn, N. Y.
Reed Engineering Co., N. Y. C.
Charles Wagner Litho Machinery Co., Hoboken, N. J.
Amer. Safety Razor Co., B'klyn, N. Y.
Merchant & Evans, Philadelphia, Pa.

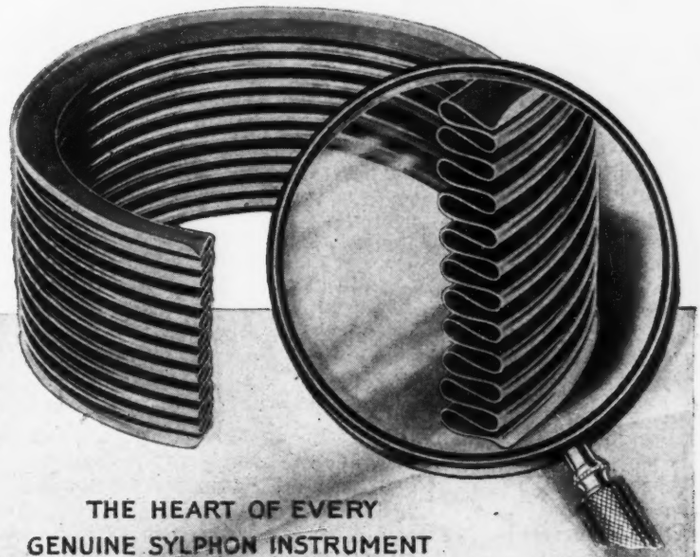
Develops Static Pressure *Overcomes Duct Resistance*

DE BOTHEZAT IMPELLER CO., Inc.
1922 Park Avenue New York City

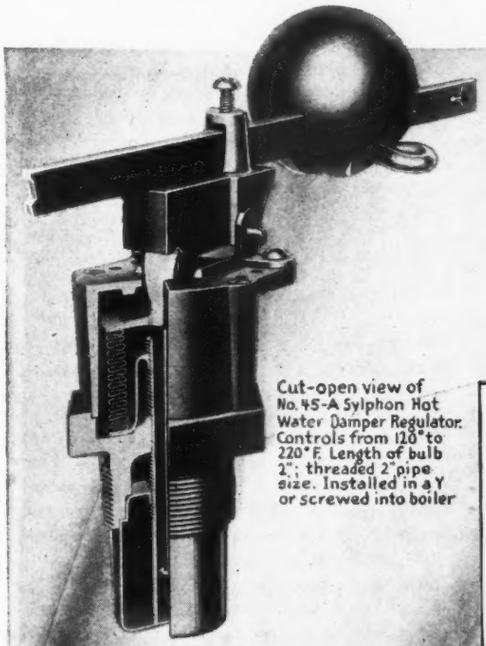
In the Heart of Every Sylphon Instrument Lies a Guarantee of Dependable Satisfaction

FOR your customer, who will benefit by dependable damper control—Sylphon Hot Water Damper Regulators are most efficient. ***Motivated by the Sylphon Bellows*** (the diaphragm recognized as the most durable, sensitive expansion unit known to science)—***they have to be***

DURABLE, DEPENDABLE, SENSITIVE



THE HEART OF EVERY GENUINE SYLPHON INSTRUMENT



Cut-open view of No. 45-A Sylphon Hot Water Damper Regulator. Controls from 120° to 220° F. Length of bulb 2"; threaded 2" pipe size. Installed in a Y or screwed into boiler

Sylphon TRADE MARK

No. 46 Sylphon Hot Water Damper Regulator. Controls from 130° to 200° F. Length of bulb 1"; threaded 1" pipe size. May be screwed into boiler, laundry heater, or garage heater.

For Hot Water Damper Regulation

Hot Water Damper Regulators are just as necessary for every hot water heating system you install as are Steam Damper Regulators for steam heating systems. They maintain house temperatures at the desired point, with a minimum of fuel consumption, by automatically opening and closing the draft dampers in quick and direct response to changes in water temperature. They assure permanent heating satisfaction on your job without costing you time or labor for servicing. Don't overlook your opportunities for installing Sylphon Damper Regulators on existing uncontrolled house heating hot water boilers, as well as on new jobs. You will not only increase your profits and your customer's satisfaction by installing Sylphon Hot Water Damper Regulators, but you will get far more uniform house heating and greater fuel economy. They are simply and easily installed, and will last as long as the boiler. *Send for Bulletin WDR-5 today.*

The well known Sylphon Bellows, used as diaphragm in all Sylphon Damper Regulators, is the most sensitive, flexible and durable

This can be done hundreds of thousands of times—
AND NO APPRECIABLE LOSS OF FLEXIBILITY WILL DEVELOP IN THE ALL METAL SEAMLESS SYLPHON BELLOWS
Sylphon

expansion unit known to science. Note the large extent of expansion and contraction, which insures smooth, positive action.

The Fulton Sylphon Company

Originators and Patentees of the Sylphon Bellows

Knoxville, Tennessee, U.S.A.

Sales Offices in: New York, Chicago, Detroit, Boston, Philadelphia and all the principal cities in U. S. European Representatives: Crosby Valve & Engineering Co., Ltd., 41-42 Foley St., London, W. 1, England. Canadian Representatives: Darling Bros., Ltd., 120 Prince St., Montreal, Can.

Peerless Heating Co., Pittsburgh, Pa., has consolidated its general offices and manufacturing plant by the removal of the offices from 5602 Baum Blvd., Pittsburgh, to the factory at Boyertown, Pa. New officers of this company which recently were elected are: E. M. Rhoads, president; Thomson King, vice-president; H. E. Gambrill, treasurer, and B. W. Frederick, secretary.

Illinois Engineering Co., Chicago, announces the following appointments: D. P. Noren, formerly with the engineering department, has been transferred to the sales department to represent the company in western Illinois; Stewart Roberts, of Chattanooga, Tenn., is sales representative in southeastern Tennessee; Alfred MacGregor, formerly with the U. S. Gypsum Company, has joined the sales engineering staff, and will operate in the Chicago district.

Brooklyn Union Gas Co., Brooklyn, N. Y., announces the appointment of F. C. Weber as assistant vice-president. Mr. Weber was formerly gas engineer of Henry L. Doherty & Company, and is past-chairman of the Technical Section of the American Gas Association, a member of the Advisory Council of the American Gas Association, and is now chairman of the Technical Research Committee.

Wade Engineering Co., Los Angeles, representatives for The Lincoln Electric Co., Cleveland, announces that its northern office has been moved from 69 Webster St., Oakland, to 533 Market St., San Francisco.

Sloan Valve Co., Chicago, Ill., announces that R. M. Nelson, vice-president of the company, has been made general manager of the entire organization. Mr. Nelson has been associated with this company for nearly 20 years.

Autovent Fan & Blower Co., Chicago, Ill., announces the completion of its new factory and general offices at 1805-1827 North Kostner Avenue. This organization started business over 11 years ago under the name of Batterman Truitt Company, changing its name about six years ago to the present one. Its officers are: President, J. E. Truitt; vice-president, E. Ackerman, and secretary-treasurer, Theodore F. LeJeune. On September 12 a house-warming party and an inspection of the new factory was held, with dancing, specialty acts and contests in the evening.

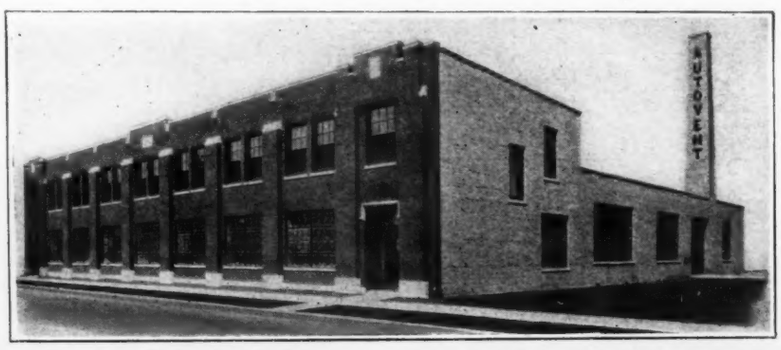
The Hays Corp., Michigan City, Ind. announces the appointment of the following sales representatives: S. Thomas Engineering Co., 6625 Delmar Blvd., St. Louis, for eastern Missouri and southern Illinois; Joseph H. Spurgeon, 3-224 General Motors Bldg., Detroit, for eastern Michigan and northwestern Ohio; H. R. N. Johnson, 621 New York Life Bldg., Minneapolis, Minn., for Minnesota and the Dakotas; Louis Towner Construction Co., 551 Valley Ave., N.W., Grand Rapids, Mich., for Grand Rapids and contiguous territory.

W. A. Russell & Co., New York, announces the appointment of Evins F. Glore & Son, Inc., as exclusive distributor in the greater New York territory, to direct "Warco" sales activities. The Glore Company is well-known to the Metropolitan trade through its activities in merchandising, heating materials, and through the long experience of its president, Evins F. Glore. The Russell selling policy will be followed and the same prices which have been established will be quoted by the new distributor. Trade promotion work in the territory has been begun by the Glore organization and the following appointments have been made: For Brooklyn and Long Island, Parke H. Holton and Abe Schulberg; Manhattan, A. H. Dyett; Bronx, C. T. Tomlinson; Westchester County and Connecticut, Lilburn H. Steel; Northern New Jersey, Samuel Barnes. In announcing the new appointment the Russell Company stated that territories outside of Greater New York are not affected by the change, except that it will enable them to give even closer attention to its sales efforts in other districts.

C. A. Dunham Co., Chicago, announces that Col. W. H. Riblet, eastern division manager, with offices in New York City, will be located hereafter in Washington, D. C., in Suite 325-327, Munsey Building. This special sales office is established as headquarters for Colonel Riblet and his assistant, Maj. W. E. Palmer. Colonel Riblet held several important offices in the government service at Washington during the World War and, therefore, will be thoroughly at home in his new location. The activities of the Washington branch sales office will be directed from this new special sales office. James P. Mewshaw, who has been manager of the company's Washington sales office, has resigned to devote all of his time to the sales representation of the Nash Engineering Company and the General Boilers Company.

Central Tube Co., Pittsburgh, Pa., announces the appointment of A. S. Lindeblad as district sales manager of the Chicago territory, with headquarters in the Peoples Gas Building, Chicago. D. M. Cooper, Jr., who has been connected with the Pittsburgh office for several years, has been appointed assistant district sales manager to assist Mr. Lindeblad.

National Regulator Co., Chicago, Ill., announces that F. C. Gibbs, recently appointed manager of the eastern office, has been forced to retire due to an injury he received. Dudley F. Parker will succeed Mr. Gibbs as eastern manager, with offices at 166 Lexington Avenue.



New Factory and General Offices of Autovent Fan and Blower Company, Chicago

Changes of Address

Barnes & Jones, makers of vapor and vacuum heating systems, are moving from 5 Melrose Street, Boston, Mass., to new offices and a new factory at 128 Brookside Avenue, Jamaica Plain, Boston, where the offices already are established and where the factory is being equipped with machinery to continue, on a larger scale, a business of 25 years' development. Barnes & Jones "condensators" and thermostatic return valves and modulation valves will continue to be leading features of manufacture. The New York address of the company will continue to be at 126 East 44th Street.

Cleghorn Co., Boston, Mass., has moved its offices and warehouse from 54 Batterymarch Street to the location at Broad and Franklin Streets.

Pierce, Butler & Pierce Mfg. Corporation has moved its New York City branch office and stock from East 162nd Street, to larger quarters at 973 Brook Avenue, Bronx. The new buildings were selected because of facilities of a 12-car railroad siding, and many new tiering devices have been installed. James E. Ryan, manager, has been with the company for eight years.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., announces the removal of its Cleveland office from the Guardian Trust Building to 1905 Guarantee Title Building.

Northern Oil Burner Co., Minneapolis, Minn., has moved to 720 Ontario Avenue, North.

Contracts Awarded

Fisher Heating Co., Memphis, Tenn., central heating plant to be housed in a new building recently erected at the Murray State Teachers College, for $44,978.

The New Helper: "Say, I never saw a line go up so fast . . . I bet we couldn't have done it with strap iron hangers."

The Old Timer: "Right you are, boy. That's why the boss buys Grinnell Adjustables . . . They knock a lot off installation costs."

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Pipe Bends—Welded Headers—Lap Joints—Piping Supplies

New Incorporations

Heating Equipment Corp., Boston, Mass., capital $100,000, to deal in heating equipment. President, Charles F. Hodson; treasurer, Stewart C. Woodworth, 199 Washington St., Boston. Incorporators: The two officers named and Walter M. Burse, Brookline.

W. H. Eddy Co., Superior, Wis., capital $25,000, to conduct a heating, plumbing, and electrical business. Incorporators: W. H. Eddy, Mary C. Eddy and John T. Larson.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

SALES ENGINEERS WANTED—Old established company, manufacturing high-grade vapor heating specialties, has some territories open at the present time. Write if you are interested in selling this line on a commission basis. State territory and other lines. All communications held strictly confidential. Address Box 105, care of Heating and Ventilating Magazine.

POSITION WANTED—Connection wanted with architects or others by engineer designing or drafting complete heating, ventilating and plumbing plans and specifications. Wide experience on all types of systems and buildings. Address Box 107, care of Heating and Ventilating Magazine.

AGENTS WANTED—By a well-known manufacturer of ventilating equipment of exceptional merits. Only men who already have experience in this line should communicate. Unusual opportunity for right, energetic men. Address Box 108, care of Heating and Ventilating Magazine.

ENGINEER WANTED—Experienced heating and ventilating engineer. Familiar with fan blast heating. Must have ability to design, estimate and supervise installations. Give full particulars in first letter. Address Box 101, care of Heating and Ventilating Magazine.

WANTED—By a nationally-known manufacturer and distributor of vapor heating specialties, sales engineers for several districts in mid-west and the east who have a high grade clientele among the architects and heating contractors, coupled with proven ability to make heating plans, marked sales ability and of high moral character, to sell vapor heating specialties and systems on a most liberal commission basis. A rare opportunity as a side line to men possessing these requirements and who already maintain an office. With your application please give your present line of business, the territory you cover, experience and age. Address Box 102, care of Heating and Ventilating Magazine.

SALESMAN WANTED—Salesman for Ohio and western Pennsylvania. Must be heating sales engineer. Prefer man who is familiar with gas-fired boiler. Address Box 103, care of Heating and Ventilating Magazine.

MANUFACTURER'S REPRESENTATIVE—Manufacturer of complete line of fans, air washers and unit heaters, desires recognized representatives on commission basis. Address Box 104, care of Heating and Ventilating Magazine.

SALESMAN WANTED—Salesman for Newark, N. J., and vicinity. Must be heating sales engineer. Desire man with acquaintance among wholesalers. Address Box 106, care of Heating and Ventilating Magazine.

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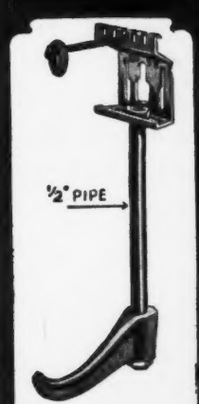

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